

QUALITY MANAGEMENT SYSTEM FOR BUILDING MAINTENANCE

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Abstract

Quality management (QM) is viewed as concepts, principles, or practices within which prescriptive views and empirical facts play roles in constructing and operating the industry to improve the performance. The growth of Building Maintenance (BM) as a proportion of the construction industry's output has led to increasing awareness of the need to manage buildings effectively. In the Kingdom of Saudi Arabia, the cost of construction projects in Riyadh City 2014 is around SR 181 billion, and that figure does include the operation and maintenance projects that cost SR 10 billion in 2014. However, this segment of the industry faces several challenges in the Kingdom. This work draws on five Quality Management Concepts (QMCs) (Total Quality Management, Six Sigma, Lean Management, Lean Six Sigma, and ISO 9001) to underpin the research principles, methodology, and implementation. From this research, The primary aim of this research is to investigate the Quality Management System (QMS) required to improve Saudi public Building Maintenance (BM) practices through the implementation of the most suitable and effective Quality Management Concepts (QMCs).

The nature of BM is examined in detail in the literature review, to ensure the subsequent collection of appropriate knowledge and information from the empirical interviews and focus group discussions. The first qualitative exercise relates to interviews conducted to collect information to examine the current BM processes in public departments, with a view to ascertaining underlying problems and assess awareness and implementation of QMCs. This was followed by a second qualitative technique, the focus group, intended to explore the most suitable and effective QMCs for implementation in BM departments. After that, the QMS was developed and then validated by focus group method a second time. In this study, thematic analysis is used for both qualitative methods.

The most significant problems facing the public BM sector were identified and then categorised into three major groups: (1) top management problems, (2) human resource problems, and (3) technical problems. The main results of the study emphasise that ISO 9001 is the most suitable foundation for quality management of BM and it is found to be an effective baseline on which the BM process can be improved. It was established that there should be specific guidelines for QM in BM (quality management system) which have been developed in this research. The QMS is customised to provide the information required to improve current practices in BM industry. It was confirmed by the evaluation and validation that the developed quality management system can generate positive outcomes, lead to better management, clear responsibilities and improve communication.

Keywords: Building Maintenance, Quality Management Concepts, Saudi Industry.

Dedication

To

My Family

This dedication is to my beloved family members. In particular it is dedicated to my mother, then to my father, to my brothers, my sisters, and my wife and daughters, for their support, encouragement, understanding and love. They have always been my best source of inspiration and faith and have enable me to soar at greater heights.

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Ayman Alshehri...

ACADEMIC REGISTRY



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Glossary of Abbreviations

BM	Building Maintenance
BMCoP	Building Maintenance Community of Practice
BMPB	Building Maintenance Price Book
BMPB	Building Maintenance Price Book
BSI	The British Standards Institution
CIB	International Council for Building
CIOB	The Chartered Institute of Building
CM	Construction Management
FM	Facilities Management
FMM	Facility Maintenance and Management
GDP	Gross Domestic Product
ISO	International Organisation for Standardisation
KACST	King Abdulaziz City for Science and Technology
KSA	Kingdom of Saudi Arabia
SDP	Saudi Development Plan
MEP	Ministry of Economic and Planning
NIBS	The National Institute of Building Sciences
PM	Project Manger
PMBOK	Project Management Book of Knowledge
RIBA	Royal Institute of British Architects
RICS	Royal Institution for Chartered Surveyors
RM	Reactive Maintenance
SA	Saudi Arabia
SR	Saudi Riyal (1 US Dollar =3.75 SR)
UK	United Kingdom

Publications and Presentation

1. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2013). The Common Problems Facing the Building Maintenance Departments In: *Presenting on the 11th International Operations & Maintenance in the Arab Countries, 11-14 May 2013, Jeddah, Saudi Arabia.*
2. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2014). Implementation the effective concept of quality management in building maintenance department. In: *Presenting on the 12th International Operations & Maintenance in the Arab Countries, 18-20 May 2014, Dubai, UAE.*
3. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2014). The Challenges affect the maintenance and safety in public building. In: *Proceedings of the Third Scientific Forum for People Working in the Field of Safety in Universities, 15-17 February 2015, Jeddah, Saudi Arabia. (Arabic).*
4. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2015). Understanding the Process of Building Maintenance in Saudi Public Sector. In: *Proceedings of the RICS COBRA Conference, 8-10 July 2015, Sydney. Published in: RICS Web Site. Formal reference CRM: 0253570.*
5. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2015). The Common Problems Facing the Building Maintenance Departments. In: *Proceedings of the 5th International Conference on Environment Science and Engineering, 24-25 April 2015, Istanbul, Turkey. Published in: International Journal of Innovation, Management and Technology, Volume 6 Number 3.*
6. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2015). Quality Manual based on ISO 9001 for Building Maintenance. In: *Proceedings of the 6th International Conference on Construction and Project Management, 10-11 August 2015, Singapore. (Formal reference # PM0004).*
7. **Alshehri, A.,** Motawa, I. & Ogunlana, S. (2015). Quality Management Concepts in Building Maintenance: Empirical Study. In: *Presenting on the 13th International Operations & Maintenance in the Arab Countries, 17 - 19 November 2015, Cairo, Egypt.*

Chapter 1: Introduction

1.1 Introduction

The construction process can be divided into three main phases, these being planning and design, construction, and operation. Maintenance is an integral part of the operation phase, and involves several activities including improvement, refurbishment and repair works of varying size and complexity of building components (Goh and Willy, 2005). In the recent decades there has been rapid growth in the construction of public buildings within the Kingdom of Saudi Arabia as part of the overall development of the country. This is characterised by increasing numbers of modern public and governmental buildings. However, the poor quality of construction has brought the need for more maintenance, rehabilitation, and renovation work in an effort to ensure the serviceability and safety of such buildings. At the same time, there is a need to sustain existing buildings for as long as possible. On the other hand, there is also a requirement to reduce the cost of maintenance work, to improve the performance of buildings and to do all these things whilst sustaining quality (Cloete, (2001), and Chanter and Swallow (2007)).

The primary aim of this research is to investigate the Quality Management System (QMS) required to improve Saudi public Building Maintenance (BM) practices through the implementation of the most suitable and effective Quality Management Concepts (QMCs). This chapter introduces the problem statement, justification of the research, an indication of the scope of the study, the precise aim and objectives, the significance of the research, and an outline of the methodology adopted and the structure of the thesis.

1.2 Problem Statement and Justification of the Study

In many countries worldwide, the construction industry is one of the largest contributors to Gross Domestic Product (GDP), and plays a significant role in determining economic growth. Indeed, according to Betts *et al.* (2011), global forecasts suggest that a total of \$97.7 trillion will be spent on construction globally during the next decade, and by 2020 construction will account for 13.2% of world GDP.

The Saudi Arabian construction industry is part of that overall surge but can be seen to have a number of special aspects related to the nation's physical resources. It is the export of oil and gas that has fuelled growth in Saudi Arabia, and simultaneously been the source

of the majority of financing for the construction sector. About 20% of the world's total petroleum reserves are located in Saudi Arabia, and the country's economic boom is being spurred on by growth in major government infrastructures and the development of construction projects (Assaf *et al.* (2010).

The World Bank's annual report 'Doing Business' (2010) has rated the Kingdom of Saudi Arabia as the 13th most economically competitive country worldwide. It highlights the rapid rate of economic growth among Middle Eastern countries, especially in the construction industry. According to a recent study, the Saudi construction industry accounts for 8% of the national GDP (KACST, 2009), and the Statistical Year Book for 2010 issued by the Ministry of Finance, reports that the Saudi Arabian Government spent £529 billion between 2005 and 2009 on construction projects. Furthermore, in 2009, the Ministry of Economics and Planning reported the total value of capital assets in the building and construction sector as 25.7 billion pounds, and the anticipated cost of maintenance and repair expenditure as approximately 5.14 billion pounds annually. However, KACST (2009) has reported that the Saudi construction industry suffers from the lack of advanced know-how, high construction costs, lack of commitment to quality, and disregard for the need to improve material properties to satisfy the Saudi Standards and Quality Organization (SASO).

With growing facilities and infrastructure, the Saudi industry has a clear need for efficient and effective maintenance programmes to guarantee the serviceability and safety of its buildings. However, as noted by Assaf *et al.* (2010), maintenance is frequently viewed negatively in most of the Kingdom's governmental offices, and to date, the government has issued no standardised guidelines in respect of quality in maintenance. Most of the maintenance work in Saudi Arabian governmental offices is undertaken by independent maintenance contractors (Assaf *et al.*, 2010), working as already indicated, in the absence of official quality standards. Among local contractors, there is a distinct lack of competitiveness, their performance is poor, they show low levels of efficiency, low productivity, high exaction costs, an inability to change, and conflict among the parties involved is evident (Ibrahim, 2006; Aichouni *et al.*, 2014).

Nonetheless, the government of Saudi Arabia has stressed the importance of BM in two of the eleven basic strategic principles included in its Ministry of Economy and Planning

(MEP), (2009) in the Eighth Development Plan Report (2005–2009). In this respect, the principles state the commitment to:

1. *Improve the quality of public services and increase their supply in line with the growing needs of the population, along with improving the performance of the responsible agencies.*
2. *Continue to provide infrastructural assets in line with growing demand, and improve their operation, with due emphasis on the maintenance and replacement of depreciated assets.*

In May 2013, the topic for the 11th Saudi International Operation and Maintenance Conference in Arab Countries was ‘*Better Maintenance toward Sustainability*’, a reflection of the continuing problem. Indeed, the conference revealed that the maintenance industry in Saudi Arabia was extremely fragile, despite the fact that it represents a huge portion of the government’s budget. A summary of the problems facing the Saudi maintenance industry emerged from the conference, includes:

- There is no agency dedicated to considering and resolving maintenance problems.
- There are no maintenance standards.
- There are complex procedures for transferring expatriate labour sponsorship to various professions between construction firms.
- There is a lack of clarity in the language used in contracts.

The main cause of these obstacles is the fact that no governmental body with the necessary authority to resolve them exists. However, the problems and challenges facing the maintenance industry in Saudi Arabia do not appear to be of serious concern to the Saudi government, and have consequently, not been addressed, such that there still remains a need for better maintenance management, proper training of personnel, and greater public awareness in the Kingdom. To date there has been no study of this subject, aimed at identifying how to improve BM practices in Saudi Arabia’s public sector KACST (2009).

Furthermore, according to a report prepared by the Ministry of Economics and Planning (MEP, 2009) the building and construction (B&C) sector in the Kingdom of Saudi Arabia has undergone remarkable changes in the last few decades. And in order to encourage the maintenance industry to become more competitive, the Saudi government has enacted

specific regulations concerning the application and implementation of Quality Management concepts (QMCs), acknowledging that quality in operation and maintenance is a major concern to be addressed if the performance of the Saudi maintenance industry is to be enhanced. Nonetheless, Saudi Arabia remains without a systematic and regular management approach to the servicing of its huge building projects, and the formulation of such an approach is urgently required (Aichouni *et al.*, 2014).

Organisations conduct quality management and improvement programmes to achieve a range of objectives. Specifically, such approaches are known to provide substantial benefits by achieving customer satisfaction, improving employee quality awareness and consciousness, improving organisational performance, and supporting partnership in value chains (Dahlgaard and Dahlgaard, 2001; Hansson, 2003; Andersson *et al.*, 2006, and Bendell, 2006). These benefits are important for all organisations, especially in developing countries, such as Saudi Arabia, where the general quality level is relatively low and needs to be increased. Many QMCs have been widely discussed and researched; however, much of the literature relating to QMCs has concentrated on the private sector, while little has focused on the public sector. The public sector implements QMCs mainly to improve services rather than for financial benefit (Booker, 2003; Crocker, 1999; Goh and Lim, 1996; Murthy *et al.*, 2002; Van de Water, 2000).

However, studies on QMCs in the field of BM are less common, leading to the need to explore this issue, especially in relation to the business process involving building clients and maintenance contractors. Ali *et al.* (2002) have argued that a lack of knowledge sharing among different parties and poor quality management cause major problems in maintenance projects. Indeed, Lee and Wordsworth (2000) also noted that poor communication between clients and contractors comprised one of the factors that negatively affect working efficiency, thereby contributing towards the relatively low productivity within the BM industry. Consequently, QMCs are believed to be necessary as a means to solve the many problems in the BM process (Ben-Daya and Duffuaa, 1995; Hansson, 2001; Backlund, and Hansson, 2002; Hill and Collins, 2000).

In Saudi Arabia the management procedures adopted by maintenance contractors are poor and result in low quality operation. Previous studies, such as that by Talal (1995), attempted to create a standardised maintenance contract by collecting essential

information from a number of government offices around the Kingdom, after studying available public building maintenance contracts. Other studies by Tawfieg (1994), and Ahmad (1995) explored the obstacles faced by the maintenance industry, and the effect of such obstacles on development in Saudi Arabia. In another study by Ikhwan *et al.* (1995), the importance of maintenance in the Kingdom was highlighted, and the need for proper education in the realm of maintenance was discussed. And in studies by Al-Hussayien (1980), Al-Hammad *et al.* (1995), and Arafah *et al.* (1995) a variety of factors contributing towards inefficiency and ineffectiveness in the BM industry were identified, such as: the absence of laws and regulations, the use of foreign standards, personal judgments employed without reference, unavailable or poorly-written operational maintenance manuals, lack of co-ordination between the construction and maintenance group, poor classification of maintenance contractors, and lack of uniform maintenance. Ikhwan *et al.* (1995) recommended an extensive assessment of the current states of maintenance management and practice in the Kingdom, and also more university-industry interaction in the field of maintenance.

Clearly, some research on maintenance management and practice in the Kingdom has been undertaken, very few articles focus on sound scientific solutions to maintenance problems, and hence, the available literature is extremely limited in its focus and range. However, with recent developments and research in maintenance industry, there is a great opportunity to investigate how QMCs can assist in managing BM sector. Furthermore, the research by Mansour (1990) had discussed the manpower requirements for operations and maintenance in Saudi Arabia, and much more recently, Hassanain and Al-Saadi (2005) addressed the system of classifying maintenance contractors. The prevailing difficulties can be seen to result from the fact that Saudi Arabia has no uniform maintenance standards or specifications for maintenance activities. Hence, maintenance work is characterised by poor quality. In Saudi Arabia no research was found that focused specifically on implementing QMCs in the BM industry.

In general, there is little studies about how public maintenance departments implement QMCs as a vehicle to improve BM processes. Hence, there is a knowledge gap in this respect, and this study focuses on identifying and assessing the available QMCs for BM. Certainly, a considerable amount of important work has been documented regarding TQM, Six Sigma, Lean Management, Lean Six Sigma (LSS), and ISO 9000, but a number of

questions remain unanswered regarding the applicability of these concepts within public BM departments.

1.3 Quality Management in the Maintenance Industry

There is empirical evidence that effective implementation of QM practices directly enhances an organisation's ability to consistently provide products and services of satisfactory quality to its customers. A large number of studies have illustrated the benefits of adopting QM in the building construction industry (see for example, Lordsleem *et al.*, 2005; Arumugam *et al.*, 2008; Cachadinha, 2009). Effective process management improves quality performance (Flynn *et al.*, 1995; Saraph *et al.*, 1989). Low and Wee (2001) claim that by employing a QM concept, work repetition, project delays and failure to meet specifications can all be minimised.

Quality management concepts (QMCs) have been put into place by large and small corporations and have proved to be successful. And in building construction projects QMCs have been shown to be essential in order to ensure that the end product is safe, meets the quality requirements, and that owners get what they paid for (Hoonakker *et al.*, 2010; Karim *et al.*, 2005). According to Hellsten and Klefsjo (2000), QM may be seen as a management system that aims to produce increased external and internal customer satisfaction and does so by using fewer resources. This management system consists of the three interdependent elements: values, methodologies, and tools (Akersten, 2002).

Many of the challenges faced by maintenance management can be readily resolved when proper procedures are implemented and a good monitoring system is put in place (Hassanain, 2013). As noted above, while BM challenges can be broad in scope, the tasks of maintenance management can be eased considerably through appropriate QMCs (Pheng, 1996). The current management of building services maintenance is not entirely efficient and satisfactory, and hence, the application of any QMC is regarded as a useful tool, with the potential to provide better control and promote significant improvements to all maintenance activities.

Today, QM is not merely an inspection and control phenomenon on the shop-floor but rather an overarching process, commencing with customer needs as input and ending by assuring an organisation delivers products and services that meet set needs (Karim *et al.*, 2005). A review of the literature suggests that many quality approaches are well-suited to

BM, especially to smaller maintenance departments. In developing a QM culture in BM departments, an important step is to develop a team of main contractors and sub-contractors who can commit to the quality process and develop a true quality attitude.

Introducing QMCs into the Saudi BM industry might be a step in the right direction to resolve the problems mentioned and create overall improvement in performance. However, in Saudi Arabia, there is no public body or agency with responsibility for studying and monitoring the maintenance industry (Ibrahim, 2006), and the implementation of QMCs has become an issue of widespread concern in the construction and maintenance industry. Indeed, while considerable research has been conducted into BM in Saudi Arabia, studies reporting the influence of QMCs on maintenance are limited. Talal (1995) attempted to create standardised maintenance contracts by collecting essential information from a number of government offices. In addition, Tawfieq (1994) and Ahmad (1995) discussed the obstacles faced by the maintenance industry and the effect of these on development in Saudi Arabia. Mohammed (1998) identified the key factors affecting the importance given to building maintenance projects. And Alarjani (1999) found that the maintenance function often encounters various problems that impact on workflow, and which may cause delays or even the cancellation of some work orders.

The answers to these questions will require the investigation of the current BM process in Saudi Arabia (SA) (as the focus domain of this study) and the suitability of QMCs to improve these processes. In addition to that, this study will examine the current QMCs practice and identify and develop any required procedures such as quality management system for BM.

1.4 Research Aim and Objectives

As indicated in section 1.1, the main aim of the research is to develop the quality management system required to improve Saudi public BM practices through the implementation of the most suitable and effective QMCs. The proposed quality management system will help top management achieve effective implementation of quality management approach and continuous improvements within the BM processes. It is anticipated that the implementation of such a quality management system would improve customer satisfaction, reflect better management and identify clearer allocation of responsibilities through maintenance processes.

In order to achieve the research aim and address the issues raised in the previous section, four objectives are identified:

The First Objective:

1. To examine the current BM processes in Saudi Arabia departments, with a view to identify the underlying problems and potential areas for improvement.

This objective will assist in mapping out the current process and discovering how best to improve maintenance processes through QMCs. It will also help to acquire more details regarding the key stages in maintenance processes, the scope for development, and the common problems encountered (human and technical) during the maintenance process.

The Second Objective:

2. To explore QMCs with a view to understand the level of awareness they enjoy among practitioners, and their applicability to public BM departments.

This objective will assist in identifying the level of awareness of QMCs within BM departments, whether there is any implementation of them, and how effective the implementation might be. Additionally, in pursuing levels of awareness, this objective explores the backgrounds of practitioners, and from this information, it identifies challenges to implementation.

The Third Objective:

3. To establish the most suitable and effective QMCs for implementation in BM departments.

This objective will assist in identifying the most effective QMC from the practical point of view. After selecting the QMC, the quality management system will be developed based on the selected QMC.

The Fourth Objective:

4. To develop and validate an appropriate quality management system for BM in order to improve business processes.

This objective will assist in developing the quality management system to be implemented in the BM process for more enhancement.

1.5 Research Significance

Building maintenance involves multiple activities, and consequently maintenance projects present challenges in terms of size, quantity of manpower required, and their overall requirements. Achieving high quality in this respect requires the effective management of interrelated maintenance department processes (Lai and Yik, 2005).

The significance of this study lies in its attempt to identify the processes undertaken by building departments in respect of their BM responsibilities, and to determine what QMCs can underpin effectiveness in this matter. Effectively, it explores the gap that exists between the theory and the practice. In doing this, the study develops a quality procedures based on the implementation of QMCs to improve the performance outcomes in the Saudi BM industry. The proposed quality management system will bring benefits for both the industry and the local economy in general, being used as a guideline by public maintenance departments to successfully prepare, develop, and apply more effective QMCs as a means to become more efficient and effective. The quality procedures will consider the communication among maintenance parties and decision-makers involved in the business process, and assist in demarcating stronger lines of responsibility.

The study will enrich the extant literature concerning QMC methodology, implementation, and practices. Moreover, it is anticipated that the outcomes of this research could be applied in other countries where the business environment is similar to that in Saudi Arabia.

1.6 Research Limitation

The study only adopts the claimant's perspective, at this stage and excludes contractors and suppliers. The owner perspective is chosen since the owner plays the major role in the public BM industry and has more authority in comparison with the other two participants (contractor and supplier), but the focus is not intended to deny their importance in the process.

1.7 Research Methodology

A multiple methods strategy involving the collection of qualitative data is employed to secure the relevant information associated with the current status of the BM process and the use of QMC practices within the Saudi BM industry.

As shown in Figure 1.1, the achievement of the Research Aim and Objectives is accomplished through six stages. The first stage involves the identification of the research gaps, and defines the study's aim and objectives through reviewing the literature (Chapters Two and Three). The second stage involves the research methodology and the collection of empirical data through in-depth interviews with professional people occupying senior positions, and possessing good knowledge and experience of BM and QMCs (Chapter Five). The third stage comprises focus group discussions with experts (Chapter Six), during which QMCs that are viable in the BM context are identified, thereby answering the third research objective.

The fourth stage develops the quality management system on the basis of the outcomes from stage three and the fifth stage is to validate the quality management system (Chapters Seven and Eight). Finally, the sixth stage draws the research to an end, reaching conclusions and highlighting recommendations for further research (Chapter Nine).

The organisations involved in the study include ministries and governmental institutions located in Riyadh City, and the participants are all from high and middle managerial levels. In total, there are 23 public organisations in Riyadh, each with their own building operations and maintenance departments.

1.8 Thesis Structure

This study is organised into nine chapters, as follows:

Chapter One: Introduction to the Thesis

This introduction offers an overview of the research background, giving a statement of the problem and the research rationale. The chapter presents the research aim and objectives, the significance of the research, research questions, methodology, and structure of the thesis.

Chapter Two: Building Maintenance

This chapter reviews the literature in the area of BM in the public sector. A comprehensive review of the published BM literature is presented as a means of identifying and synthesising the knowledge pertaining to BM processes and problems related to the industry. This chapter defines the research gap and confirms the need for the study.

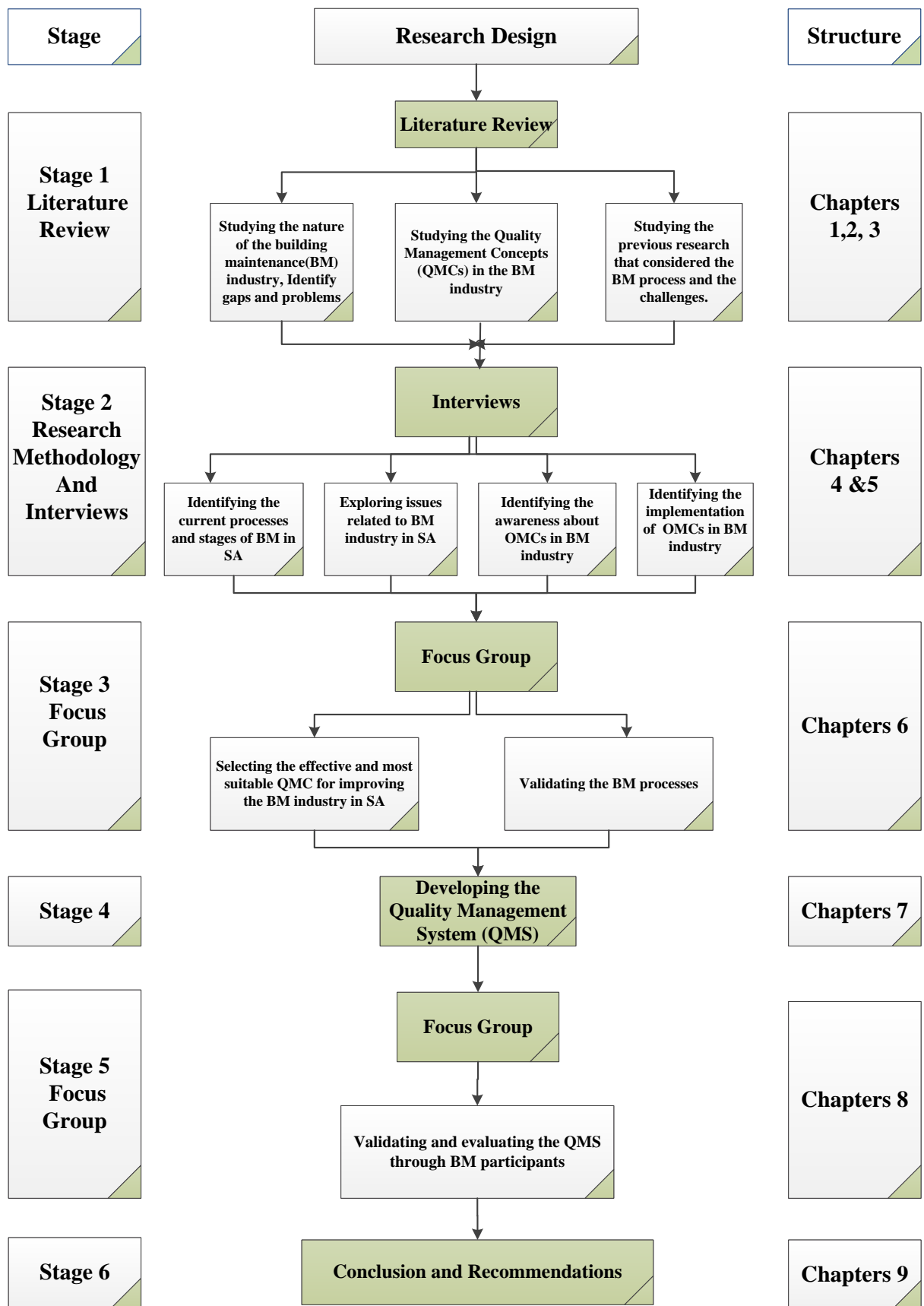


Figure 1.1: Overall Research Plan

Chapter Three: Quality Management Concepts (QMCs)

This chapter reviews the literature related to the five QMCs in the field of public BM. It clarifies and describes the similarities and differences between TQM, Six Sigma, Lean Management, Lean Six Sigma, and ISO Quality Management. In doing so, it shows that these concepts share many similarities, especially concerning origin, methodologies, tools and effects, and it provides an overview of all five QMCs, including definitions, conceptualisation, methodology, principles, and application.

Chapter Four: Research Design

Chapter Four presents the research plan, data collection methods, interview protocol, focus group discussion and types of analysis used.

Chapter Five: Interview Results

This chapter provides and discusses the findings of the 12 interviews conducted to explore the BM process and identify underlying problems. It reveals levels of current awareness in Saudi Arabia of QM in general, and the five QMCs in the BM sector in detail, and highlights the main barriers faced during the implementation of QMCs.

Chapter Six: Focus Group Discussions Results

This chapter presents the findings obtained from the four focus group sessions, undertaken to discover the most suitable and effective QMCs, and to validate the general BM diagram.

Chapter Seven: Development of the quality management system

The development of the quality management system based on ISO 9001 is described in Chapter Seven, and the quality management system itself as prepared for BM departments is presented.

Chapter Eight: Validating the quality management system

Chapter Eight validates the quality management system as being capable of meeting the requirements for improvements to the BM process.

Chapter Nine: Conclusion and Recommendations

This final chapter concludes the thesis. It draws a conclusion and highlights how the study

outcomes have contributed to the body of knowledge, body of policy, body of practice for the building construction industry, and especially the BM sector. It then discusses limitations to the research and offers recommendations for future researchers.

Chapter 2: Building Maintenance Management

2.1 Introduction

This chapter is the first of two chapters which review the literature appropriate to the study. It presents the published literature in the area of BM management, as a means of identifying the precise research issues, focusing specifically on BM processes and the associated problems they have within the overall industry.

The chapter begins by providing definitions of the BM concept, and proceeds to discuss the position of maintenance within organisations. It then presents an overview of the problems facing the maintenance industry, introduces the different types of maintenance, and considers the parties involved in the BM process. A number of studies conducted to date through the use of particular process models are then briefly discussed. With this comprehensive understanding of BM, the particular situation of the Saudi maintenance industry is then introduced. This includes an indication of the importance of the maintenance industry to the Kingdom, and the specific challenges it encounters. Thereafter, the chapter considers the potential for Quality Management Concepts to assist in reducing these challenges, and it ends with a short summary.

2.2 Building Maintenance

From the literature it can be seen that the subject of BM has received considerable attention but with regard to the specific issue of the factors that influence public BM projects, there is a noticeable shortage of articles. Building maintenance demands a combination of administrative and technical actions to ensure all elements of a building are at a required standard to perform its intended function (Wordsworth, 2001). It is necessary for buildings to show a good level of functionality, since they represent one of the most valuable assets of a nation, providing as they do, facilities for work. And as time passes, the maintenance of buildings becomes an invaluable process in retaining their value and quality (Vijverberg, 2002). Building maintenance accounts for over half of the total output of the building industry worldwide (Wordsworth, 2001). Clearly it can be seen as a vital component of the industry, and as noted by Lam *et al.* (2010), in order to execute BM tasks efficiently, a proper BM plan and monitoring system is essential.

The literature provides several definitions and objectives of BM. Francis *et al.* (2001), for example, state that BM is an operation involving the interaction or combination of technical, social, legal, and fiscal determinants that govern and manage the use of buildings. It can be seen as a complex operation, yet arguably, many people do not understand its importance and/or the need for its proper management (Syahrul, 2009). recently, Lee and Wordsworth (2001) claimed that the main objective of a maintenance management organisation is to ensure an acceptable standard and level of service is provided continuously, and at minimum cost.

Buildings must be considered both as facilities and assets, and this requires viewing maintenance in a wider context. The British Standards (BS 3811:2010) define maintenance as: “*A combination of any actions carried out to retain an item in, or restore it to an acceptable condition*”. From this definition it can be observed that action is considered not only in reference to the physical execution of maintenance work, but also in regard to initial planning, financing, and management. Furthermore, understanding all the requirements for effective BM implies that acceptable conditions within a building be present. At the same time, however, what is regarded as acceptable conditions depends on the building type, and can be interpreted differently from person to person. Hence, the complexity of the concept is enhanced.

Given the definitions mentioned, it is seen that the objectives of BM are:

- To ensure that buildings and their associated services are in a safe condition.
- To ensure that the buildings are fit for use.
- To ensure that the condition of the building meets all statutory requirements.
- To carry out the maintenance work necessary to maintain the value of the physical assets of the building stock.
- To carry out the work necessary to maintain the quality of the building (Syahrul, 2009).

The above objectives are not easily achieved, however, and the universal problems that negatively affect the maintenance of building services must be considered. In the following sections, these problems and challenges are explored.

2.3 Problems Facing the Maintenance Industry

The maintenance industry in general is facing numerous problems that affect its growth, and the purpose of this section is to present a brief description of those problems as they influence the operation and maintenance industry.

2.3.1 Poor Maintenance Management

According to Lam, (2001), the main objective of maintenance management is to minimise the need to repair of building defects, by enhancing planning and implementation, and adopting suitable materials and tools for the initial construction. Effective maintenance management should have a clear strategy for corrective, preventive, and condition-based maintenance. This includes ensuring that failure to execute maintenance at the right time does not occur, as according to Narayan (2003), failure or delay when executing maintenance actions can cause further excess damage, wear and defects. Thus, additional maintenance works must be performed in order to treat problems. Lack of documentation regarding maintenance work also leads to problems and higher maintenance costs in the long term (Lam, 2001).

2.3.2 Poor Quality of Spare Parts

Poor quality of spare parts and the materials used in building components, elements, services, and or facilities, significantly influences maintenance costs. Clearly, the use of spare parts is necessary in maintenance activities, but as identified by Al-hammad *et al.* (1996), problems related to the lack or unavailability of required spare parts, tools, and or materials to perform maintenance tasks, do occur. As a result, poor quality or second-hand spare parts are sometimes acquired for maintenance tasks, and not surprisingly, this poor quality may have a direct effect on the performance of elements or the systems to be maintained.

2.3.3 Poor Performance of the Maintenance Team

Team effectiveness is central to the success of any project. Since maintenance is performed as teamwork, the factors that increase the effectiveness of the work of a team should be taken into account. If a team is ineffective, this will affect the productivity of the workers and increase the cost of maintenance (Azmy, 2012).

2.3.4 Budget Constraints

Pascual *et al.* (2008) stated that the asset or building failure rate increases as time passes and this produces a higher number of repair and maintenance tasks. It is often seen that delay in maintenance tasks has occurred because the budget allocated is not sufficient to cover the need for maintenance (El-Haram and Horner, 2002), and maintenance managers continuously complain about the insufficient funding earmarked for maintenance work, since any limitations in funds will proportionally decrease the amount of maintenance performed.

2.3.5 Lack of Training

Poor training is likely to negatively influence maintenance costs. Indeed, Narayan (2003) states that the absence of maintenance skills in personnel training is one of the reasons for poor operating practices. Inadequately trained staff produce defective work, show reduced productivity, and cause accidents, as they use unsatisfactory operating and maintenance practices. Human error and poor quality maintenance outcomes are the logical result of no or poor training, and as noted by Colen and Lambrecht (2012), ultimately, this lack of attention to, and investment in training, contributes to higher maintenance costs. Undeniably, maintenance skills are essential if good maintenance performance is to be achieved (Pascual *et al.*, 2008).

2.3.6 Poor Communication

Poor communication between maintenance groups and end users is another problem since this results in focusing on maintaining areas that are not necessarily the main cause of a defect identified. Hence, it can result in additional work, which eventually escalates maintenance costs (Hua *et al.*, 2005).

Although it is unlikely that the various problems identified can be completely overcome without the input of further resources, it is possible to improve the situation by ensuring the best solution is achieved by maintenance departments. An improved level of performance in the area of maintenance requires an assessment to develop better practices for maintenance management, which will then achieve greater effectiveness in terms of maintenance planning and execution, through the pursuit of QMC practices.

2.4 Building Maintenance within Organisations

Any study of a maintenance department must take into consideration the position of that maintenance department within the public organisation itself, and the importance of the condition of the buildings therein, since these factors influence operational details, and the manner in which maintenance work is performed. The position of a maintenance department within an organisational structure, and its relationships with other departments and functions is a focal point from which the importance of maintenance departments to top management is deduced (Albert, 2005).

Within the public sector, diverse building types may exist to serve various functions. However, many of these buildings are not seen as generators of income, but rather as a means by which society's needs are met. Although market pressures may be limited to effect building functionalities, there may be other pressures, social and political, as well as economic (Lee and Scott, 2009). Clearly, where an organisation has outsourced maintenance, the positioning of the responsibility for monitoring and control needs to be rethought; this may lead to a need for more strategic management levels.

It is crucial to appreciate the main objectives and responsibilities of the maintenance department to provide a clear understanding about the business process practice. In this respect, it is the case that maintenance departments are responsible for the management of buildings and engineering services. Hegazy (2010) breaks this function down by noting that the term maintenance department is used to describe the body responsible for planning, control, and execution of maintenance operations. The 'maintenance' objective of maintenance management is to prevent, to minimise, and repair building defects by enhanced planning and implementation using appropriate materials and tools at the right time and at minimum total life-cycle cost. The building in question may be overseen by an in-house team or independent bodies such as contractors for maintenance management (Barrie and Peter, 2007). Clearly, the relationships between maintenance bodies and the remainder of any business organisation must be carefully considered, as they may influence operational and management approaches and methods (Wu, 2010).

The organisation responsible for dealing with maintenance must address two major issues. Firstly, it must ensure that it provides an appropriate service within established guidelines and in accordance with corporate objectives; and secondly, it must be capable of judging

its own effectiveness (or that of an external provider) through performance monitoring and control. The need to satisfy these two interlinked issues underlines the importance of the interface between the maintenance provider and the rest of the organisation (Wordsworth, 2001).

Various titles are given to maintenance departments, for example, property division, facilities department, administration department, asset management department, but irrespective of these differences in name, they have the same common aim. According to Seeley (1987), the functions of maintenance organisations include determining maintenance policy, assessing funding requirements, preparing and monitoring maintenance costs, and implementing feedback. Additional functions include organising maintenance work, monitoring progress, and providing advice on new organisational developments. In reality, many organisations prefer to outsource non-core services (Marsh, 2003), and large enterprises with many buildings in their portfolios, often prefer to outsource their maintenance requirements to a dedicated maintenance organisation, particularly, considering the significant contribution of effective buildings maintenance to corporate businesses (Chanter and Swallow, 2007).

Undoubtedly, as already indicated, BM is a complex task, yet it is usually placed at the bottom of the agenda in terms of the national budgets of many countries. And in most public organisations, it is perceived as a non-core service activity, best outsourced to speciality contractors. Indeed, the move towards outsourcing is presumed to be client-driven as organisations seek to focus on their core activities and divest themselves of the responsibility for non-core business (McIvor *et al.*, 1997; Blumberg, 1998). Moreover, the fact that BM can be divided into different types, as discussed in the following section, makes it more difficult to provide this in-house.

2.5 Types of Building Maintenance

Cloete (2001), and Chanter and Swallow (2007) state that maintenance can be classified as planned and unplanned. Cloete (2001) further sub-divides planned maintenance into two main sub-categories, these being, planned preventative maintenance which is work directed to the prevention of failure of a facility in order to ensure continued operation, and planned corrective maintenance which is work undertaken after failure has occurred. Cloete (2001) makes reference to Seely (1987, who further sub-divides planned

preventative maintenance into scheduled, and condition-based maintenance. The more common practice of scheduled maintenance is defined in Chanter and Swallow (2007) as preventative maintenance carried out to a predetermined interval of time, number of operations, mileage, etc.

Chanter and Swallow (2007) make reference to the British Standards Institute's definition of unplanned maintenance, that being, it is ad-hoc maintenance carried out to no predetermined plan. Cloete (2001) refers to unplanned maintenance as work necessitated by unforeseen breakdowns or damage due to external forces. Suttel (2006) states that ideally, the ratio should be 70% planned preventive maintenance and 30% planned corrective maintenance. Figure 2.1 provides an overview of the classification of maintenance as defined by Chanter and Swallow (2007).

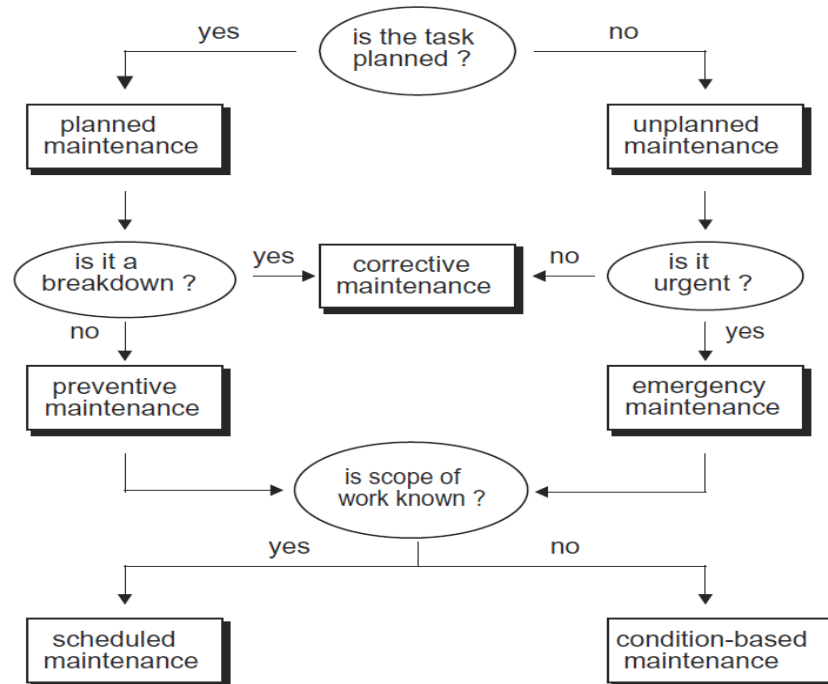


Figure 2.1: Type of Maintenance (Chanter and Swallow, 2007).

BSI 3811 (1993) categorises maintenance into the following seven types: *planned maintenance*, *preventive maintenance*, *unplanned maintenance*, *corrective maintenance*, *emergency maintenance*, *condition-based maintenance*, and *scheduled maintenance*. The BSI 3811 (1993) defines these maintenance terminologies as follows:

1. **Planned Maintenance:** maintenance organised and carried out with forethought, control, and the use of records, to meet a predetermined plan.
2. **Unplanned Maintenance:** ad hoc maintenance carried out, but not to predetermined plan.
3. **Preventive Maintenance:** maintenance carried out at predetermined intervals, or corresponding to prescribed criteria, and intended to reduce the probability of failure, or the performance degradation of an item.
4. **Corrective maintenance:** maintenance carried out after a failure has occurred, and intended to restore an item to a state in which it can perform its required function.
5. **Emergency maintenance:** maintenance that is necessary to repair a fault immediately to avoid serious consequences.
6. **Condition-based maintenance:** preventive maintenance initiated because of knowledge of the condition of an item, obtained through routine or continuous monitoring.
7. **Scheduled maintenance:** preventive maintenance carried out over a predetermined interval of time, number of operations, mileage, etc.

Irrespective of the type of maintenance performed, however, there are various parties involved in the overall process, and these parties are now discussed.

2.6 Involved Parties in the BM Industry

The complexity of BM requires input and co-operation from several parties. In this respect, Yik *et al.* (2009) note that the performance of maintenance tasks demands work arrangement and approvals, and that these may differ according to project characteristics, management style, and work environment. Clearly, numerous individuals are involved, and without effective collaboration, work orders may not be completed. Stakeholders in the overall BM process are noted as being the building owner(s), users, and maintenance contractors (Goh and Willy, 2005); building clients may be occupiers who actually own the buildings in question or others who have leased the building space; users may be the building client's employees who occupy a building or employees of an organisation who pay rent to use the space provided by a building owner; and maintenance contractors responsible for BM work repair building defects and upgrade facilities to meet the expectations of building clients or users. The attitudes of each involved party play a major role in determining the efficiency of workflow as well as in the execution procedures of

the maintenance operation. Given the focus of this study on the owner, the contractor's and the user's roles will only be briefly discussed.

The building owner is the principal co-ordinator of the maintenance operation and the person who determines work standards, specifications, and workers' qualifications. The owner is considered the most responsible party in determining maintenance standards, setting priorities for work programmers, and monitoring the overall performance (Ali *et al.*, 2006). Additionally, the owner represents the fundamental influence in the establishment of maintenance management practices (Lai and Yik, 2006). In most cases, as observed by Clark (2005), the owner assumes the role of leading the management team, and so doing, secures adequate and professional training for his/her team, in the knowledge that poor management may substantially reduce the effectiveness and the quality of any work operation. Indeed, it was recommended by Horner *et al.* (1997) that "*owners should take the initiative on improvements in contracting methods, project execution, and relationship between the parties*". In this respect, the owner must define and establish a work and management policy that is clear and simple such that the actions of contractors are more effective (Chanter and Swallow, 2007). Effectiveness and efficiency are important considerations since as noted by Ali (2009), maintenance management quality significantly affects the BM cost. In particular, effective BM can reduce the chance of disputes, conflict, and corruption.

The speed of work execution in BM is a function of contractor performance in terms of time and quality, and the building owner in terms of approval (Ali *et al.*, 2002, 2004). When a building owner or user considers that there is a demand for repair or upgrading work, a 'work requisition' is sent to maintenance contractors instructing them to complete such work. After the owner selects a contractor and transfers all execution duties to him/her, the contractor's role becomes critical because as indicated by Goh and Willy (2005) it is the contractor's responsibility to provide all the required materials and manpower to undertake the work orders. In most projects, the objectives of the owner and contractor conflict since the former always seeks to minimise costs, while the contractor is concerned with maximising profits (Ali *et al.*, 2002). However, the focus on minimising costs may lead the owner to choose the lowest-bidding contractor, who may not actually be qualified to perform the work required. In this scenario, lower maintenance standards may be accepted, which subsequently have a negative impact on future maintenance costs.

On the same theme, the contractor may hire unqualified sub-contractors, employing low paid semi-skilled or unskilled labour, using lower quality materials or under-staffing the operation.

The CIOB (2010) stating that *“Because of the industry’s practice of accepting the lowest tender for work, it is quite common for initial savings to be made up by high maintenance costs in the future”*. In this case, the ability of the contractor to produce quality and timely maintenance will be impeded by the overall performance of the sub-contractor or workers involved. Furthermore, a contractor may choose to save money through substituting materials or spare parts with others of lesser quality or neglecting to perform certain preventive maintenance jobs. Undoubtedly, these tendencies affect the work execution negatively in both the short and long term.

Finally, the user’s co-operation is an important factor which affects the level of performance in all stages of any maintenance operation. The extent of such co-operation is reflected in the user’s behaviour in using the building and equipment, facilitating access to maintenance workers on schedule, and in reporting maintenance problems promptly. User co-operation is known to have a great bearing on the scheduling of maintenance jobs (Almarshad *et al.*, 2010).

Having considered the major players in BM, it is important to understand the business process of BM management and its functionality; and with regard to maintenance, the need, classification, and implementation must be appreciated. These issues are now discussed.

2.7 Business Process of the Building Maintenance Industry

Maintenance is defined as the combination of all technical and administrative actions, including supervisory actions, intended to retain an item in, or restore it to, a state where it can perform a required function (Wu, 2010).

Process is basically an activity to convert (deliver) input into output (product/services). Harrington (1991: 178) defined process as *“any activity or group of activities that takes an input, adds value to it and provides an output to an internal or external customer”*. People in an organisation work together on the activity to achieve some desired outcome (Ould,

1995). A “Process” can be defined by ISO 9001 as a “*Set of interrelated or interacting activities, which transforms inputs into outputs*”. These activities require allocation of resources such as people and materials. Figure 2.2 shows the generic process.

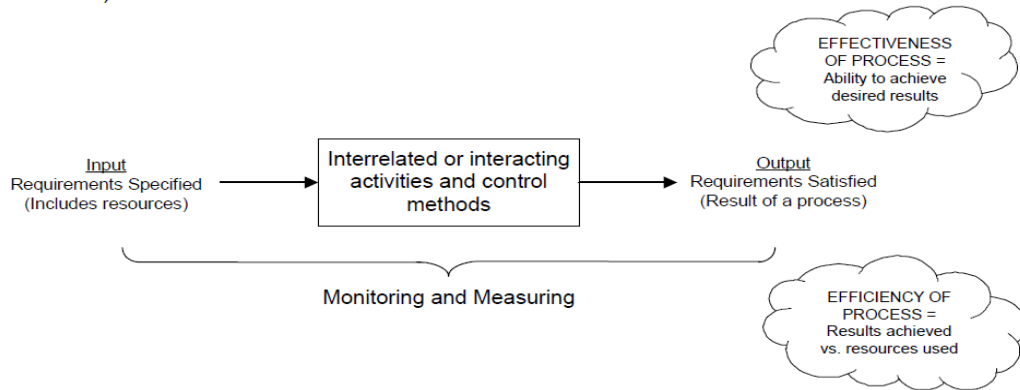


Figure 2.2: Generic Process (ISO 9001).

The combination of generic maintenance activities or actions that are repeated and transform input into output may be seen as a maintenance process (Campbell and Jardine, 2001). The purpose of the maintenance process is to sustain the capability to deliver services, record problems for analysis, take corrective, adaptive, perfective, and preventive actions, and confirm restored capability (Ali et al., 2006).

The purpose of the process approach is to enhance an organization’s effectiveness and efficiency in achieving its defined objectives. Benefits of the process approach are:

- Integration and alignment of processes to enable achievement of planned results.
- Ability to focus effort on process effectiveness and efficiency.
- Provision of confidence to customers, and other interested parties, about the consistent performance of the organization.
- Transparency of operations within the organization.
- Lower costs and creates shorter cycle times, through the effective use of resources.
- Improved, consistent and predictable results.
- Provision of opportunities for focused and prioritized improvement initiatives.
- Encouragement of the involvement of people and the clarification of their responsibilities.

Maintenance work has been described as fragmented and scattered and often very difficult to supervise, organise, control, and execute (Holmgren, 2003). Therefore, before starting work execution, certain procedures and priorities must be established.

In order to identify the current BM process in Saudi Arabia, it is necessary to be aware of the BM processes that have been identified in the literature. Consequently, several studies are now reviewed to establish what different processes exist and whether any of these can be adopted, or customised for the Saudi industry.

The first study describes the maintenance projects undertaken at the University of Salford, through the use of a process model for reactive maintenance, developed by Ali *et al.* (2002). Figure 2.3 illustrates the interactions between four different parties: the client, the FM agent, the contractor, and the suppliers. The flowchart technique was used to map the whole process, and the problems highlighted by the parties involved can be summarised as [1] poor communication among different parties in the process, [2] lack of knowledge sharing, and [3] poor quality of information.

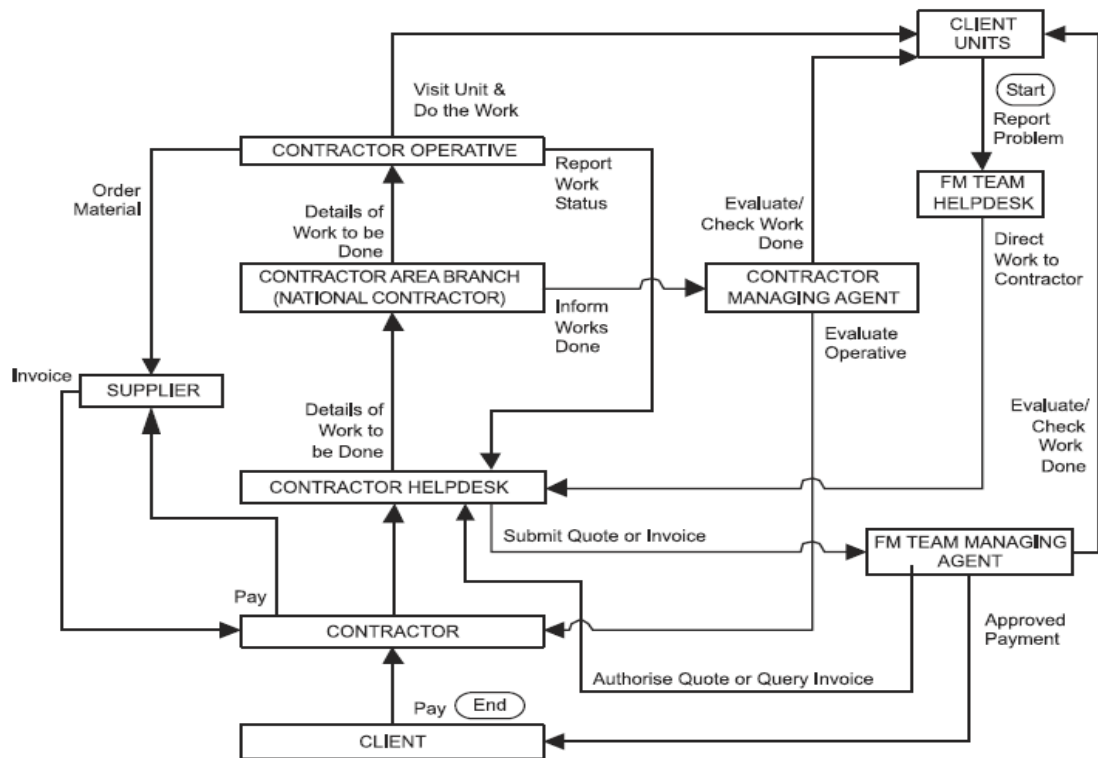


Figure 2.3: Reactive Maintenance Project – High Level Business Process (Ali *et al.*, 2002)

The second study refers to a public department in Kuwait. Figure 2.4 illustrates a typical BM process, developed by Almarshad and Motawa (2012), which consists of the main team members, and the types of activities and processes that might be conducted. The main aim of the study, like the previous one, was to identify opportunities for improvement, particularly in the area of knowledge management, knowledge management systems, communication, and data sharing.

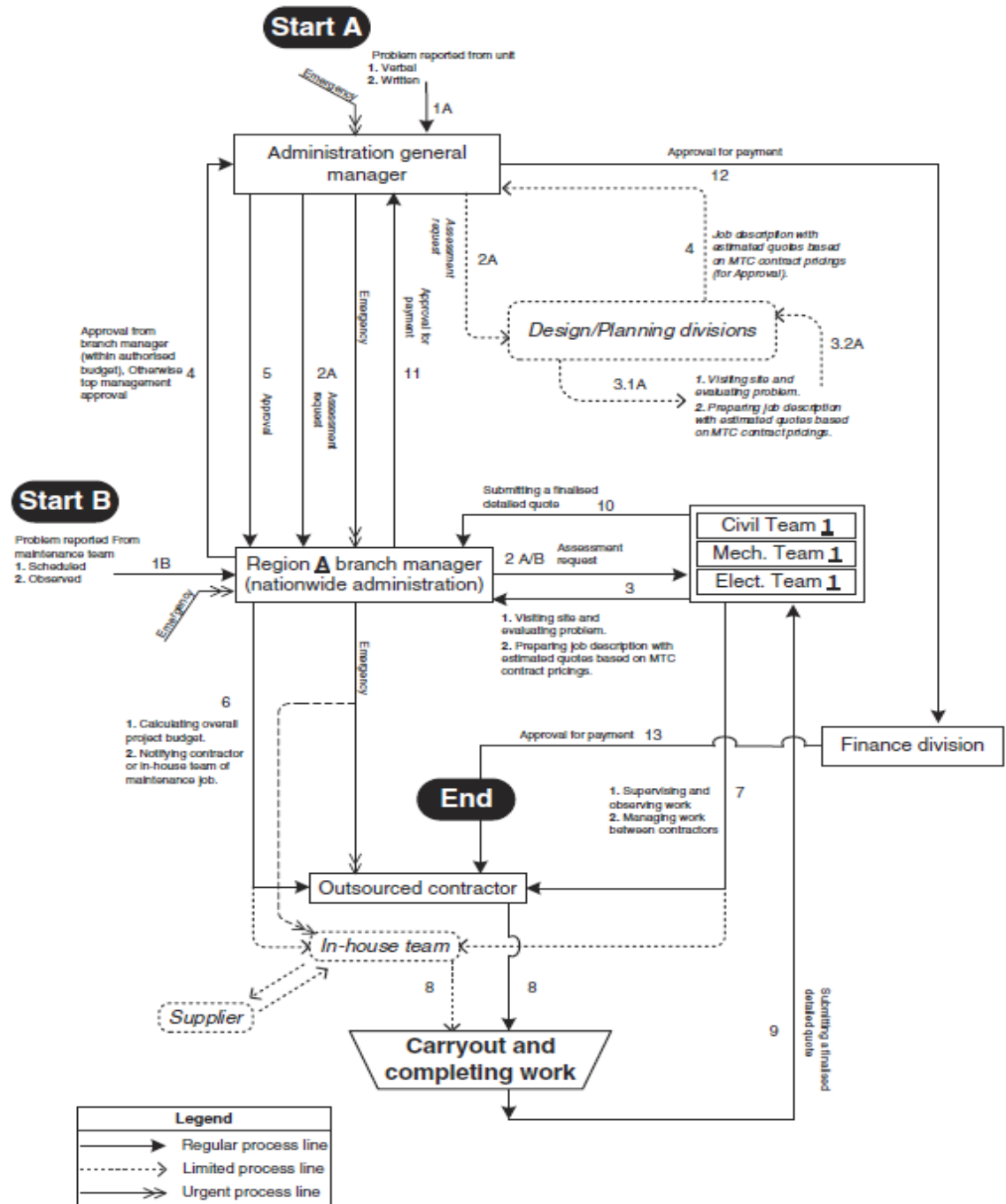


Figure 2.4: BM Process in the Public Sector (Almarshad and Motawa, 2012)

The purpose of the third study, shown in Figure 2.5, was to develop a process model for the management of maintenance of school buildings (SBMM Process Model) using the IDEF0 structured modelling technique. The model depicts a three-stage process involving data gathering, development of a draft model, and verification of the draft model. Information about existing maintenance practices was obtained through questionnaires and documentary analysis, during which policies, standing orders, and maintenance reports were examined. The strength of the process model resulting after the verification stage, lies in the fact that it can provide detailed concrete evidence of the relationships between four management parameters namely maintenance activities, maintenance objects, human resources, and materials.

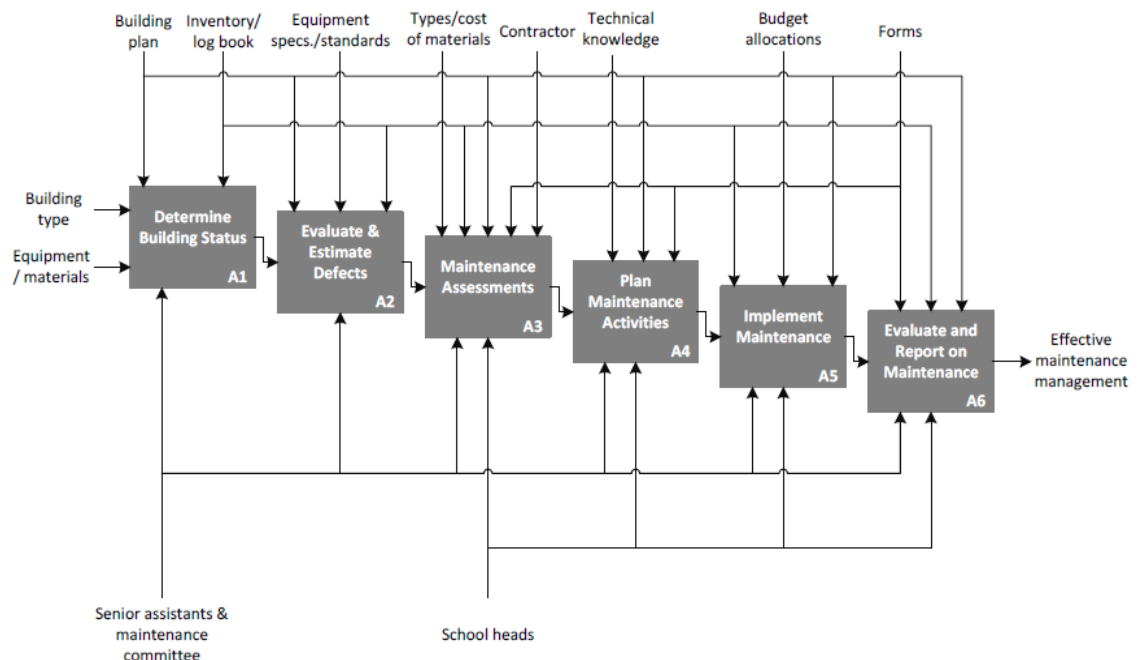


Figure 2.5: Process Model for the Management of Maintenance of School Buildings (SBMM)
(Akasah and Amirudin, 2006)

The fourth study forms part of ongoing research on the development of a systemic BM model for universities in Malaysia. There are many university buildings in Malaysia which are in poor condition and performing below expectations. However, many of the problems are related to poor management practices. The case study illustrates the procedures involved in BM management, which are designed to suit the capacity of the organisations. Figure 2.6 illustrates the flow chart of maintenance management processes.

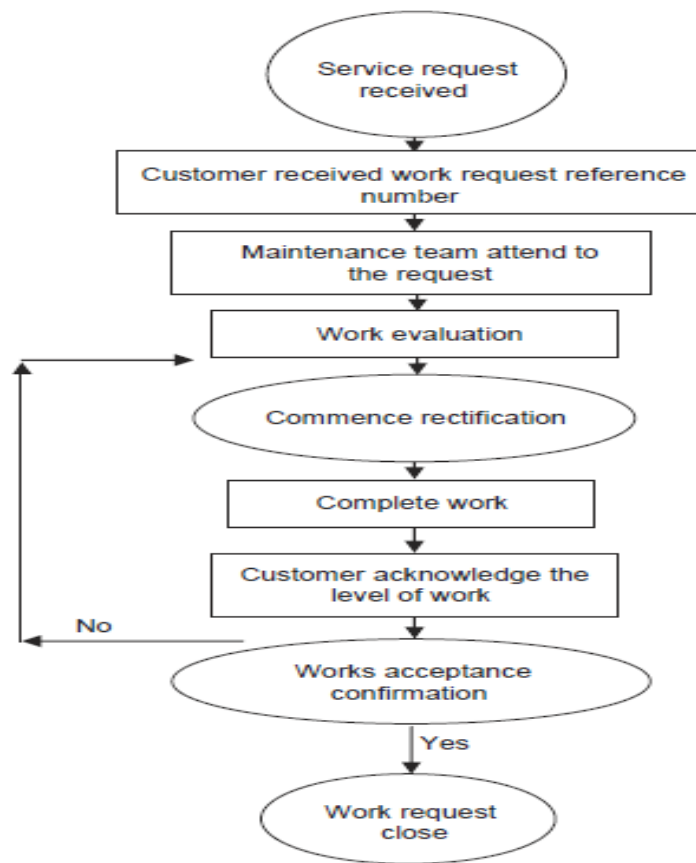


Figure 2.6: The Flow Chart of Maintenance Management Processes (Olanrewaju et al., 2011)

The fifth study developed a model based on a generic process view of maintenance, and that consists of four interrelated activities: Maintenance Planning, Maintenance Execution, Functional Testing, and Feedback (see Figure 2.7). The process model is intended to support continuous improvement of, and continuous risk reduction in maintenance activities. The maintenance process presented is based on the four phases of the Improvement Cycle (Plan-Do-Study-Act), as described by Deming (1993).

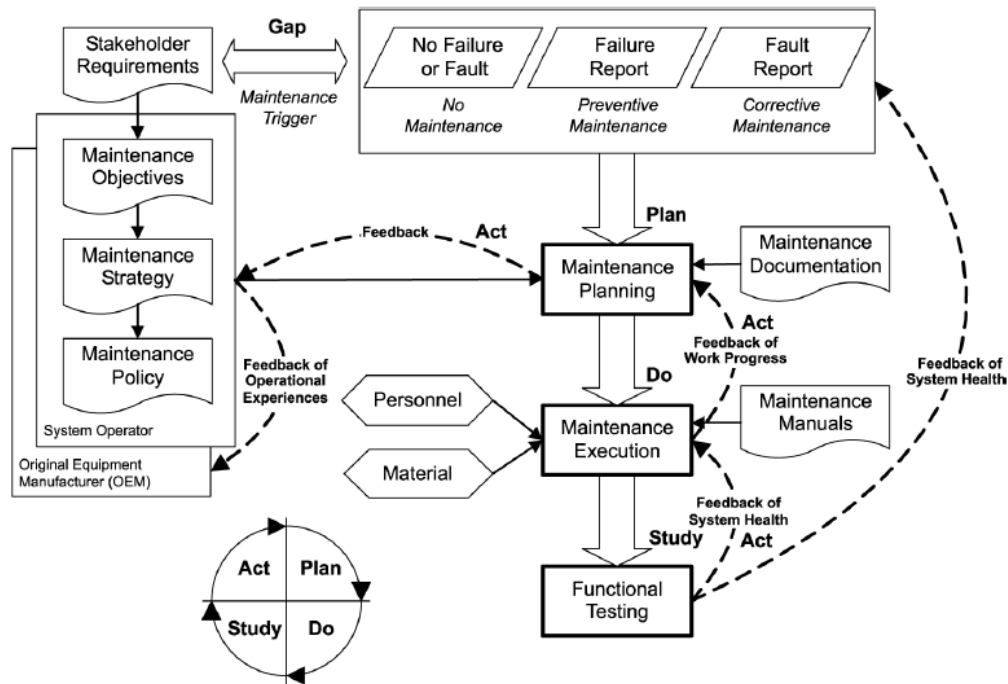


Figure 2.7: The Flow Maintenance Process - Maintenance Planning; Maintenance Execution; Functional Testing; and Feedback (Soderholm *et al.*, 2007)

The review of the above-mentioned studies indicate that efforts to map the maintenance management process are important as a first step in the development and improvement of the process. In addition, BM organisations follow different routes, based on several factors such as organisational structure, size, business functions, and type of beneficiaries. This study will later investigate how public BM sector in Saudi deliver its services. This will be done through mapping the business process of public BM departments. The output of such investigation establishes understanding of the adopted processes which will help identify deficiencies that hinder delivery of BM service.

However, a second step is to clarify the type of maintenance required, and in this connection it is necessary to consider the BM industry involved and any peculiarities associated with it. Consequently, the following section discusses the Saudi maintenance industry and its experience in delivering BM services.

2.8 The Building Maintenance Industry in Saudi Arabia

In introducing the BM industry in Saudi Arabia, this section considers firstly the national economy, and secondly the construction industry, which embraces the operation and maintenance sector.

2.8.1 Saudi Economy

Having the world's biggest oil reserves and being the world's largest oil exporter, Saudi Arabia has succeeded in creating a robust, dynamic economy and establishing itself as one of the most enterprising nations in the region. Consequently, with its huge revenues derived from increases in oil prices and oil production, the Saudi government has been able to significantly develop the national infrastructure, which has included the construction of more buildings of various kinds. Indeed, during the period covered by the Eighth Development Plan, the building and construction industry experienced an average annual growth rate of 7.1%, which according to the MEP (2009), signified substantial growth. In 2008, the total value of capital assets in the building and construction sector was 25.7 billion pounds, and the anticipated cost of maintenance and repair expenditure per year was around 5.14 billion pounds. In addition, in the first four years of the Eighth Development Plan, there was a rise in the total number of building permits granted to all facilities. The social services facilities and government facilities comprise the biggest proportion at 47.7%, non-residential facilities (industrial and large commercial) account for 13.2%, and educational and health facilities, and mosques account for 12.1%.

In keeping with the increase in construction-related spending, the number of registered contractors increased from 3,690 in 2002 to a total of 9,448 in 2007, representing 27.7% of the total registered companies in the country that year (KACST, 2009).

Given the continuing budget surpluses from strong oil revenues, it is expected that the spending on the construction sector will continue to grow, confirming Saudi Arabia's construction industry as being the largest one in the Middle East, and hence, one of great significance as indicated in the following sub-section.

2.8.2 The Construction Industry in Saudi Arabia

With the steady economic development in the Kingdom of Saudi Arabia in the last few decades, a vibrant and expanding building and construction (B&C) sector has emerged, in

remarkable contrast to the situation in earlier times (KACST, 2009). Now the Saudi construction sector consists of a series of activities related to various types of buildings and engineering structures, as well as related maintenance. Not surprisingly, this sector is regarded as an important and reliable indicator of the direction and health of the national economy (MOP, 2009).

Involving projects amounting to multibillion Saudi riyals, the Kingdom's construction industry is the largest in the Middle East, leading the way in the region's infrastructure and construction spending growth. It is reported that Saudi Arabia awarded US\$ 66 billion (SR247.5 billion) worth of projects in 2011, this representing a 6% increase over the value of projects awarded in 2010. Saudi Arabia was the largest projects market in 2011, accounting for 55% of the US\$120 billion (SR450 billion) worth of contracts awarded in the Gulf Co-operation Council countries. And in 2013, the project market in Saudi Arabia grew by a further 10% to reach US\$72 billion (SR270 billion) according to industry analysts. Moreover, the market will be stimulated by US\$300 billion (SR1.13 trillion) worth of contracts yet to be awarded in the construction, petrochemicals, and power sectors (MOP, 2012).

According to the 2014 Annual Report from the High Commission for Development of Riyadh City (HCDR), the total number of government construction projects was 2,824 amounting to a cost of around SR 181 billion, and that figure does include the operation and maintenance projects that cost SR 10 billion in 2014. The year before (2013), there were 462 projects amounting to SR 51.4 billion, showing a 29% increase in the value of projects awarded in 2010.

As already indicated, the annual public spending on construction is largely affected by oil prices, which have remained steady and high for several years. Table 2.1 illustrates the building construction projects funded by the Saudi government in different centres within Riyadh City, the country's capital.

The new and modern buildings reported in Table 2.1, being funded by government, are commonly constructed using high quality fabrics and include sophisticated facilities like air-conditioning systems, lifts, fire service installations, etc. All these buildings, whether old or new, are not sustainable without proper operation and maintenance (O&M) (Lai,

2010). It should be noted also that Table 2.1 reports only the situation in Riyadh City, which whilst being the capital, is nonetheless, not the only Saudi urban development, and is characteristic of many others.

Project	Cost (Millions SR)	Status of project progress	Sector
The campus in King Saud University	9,056	77%	Educational services sector
The campus in AL Imam University	2,703	78%	
Facilities Expansion in AL Imam University	800	32%	
Facilities Expansion in AL Karaj University	412	72%	
Prince Salman University	224	81%	
Expansion in Health City at King Saud University	1,803	73%	Health services sector
Mental Health Hospital	406	Under tendering process	
Health Nerve Center	300	Under tendering process	
New Hospital in Riyadh (300 Beds)	260	53%	
Expansions of King Khaled Airport	3,100	15%	The transport sector
Information Technology Complex And Communications	6,414	65%	Economic Development Sector
5 star hotels in King Saud University	348	37%	
King Abdullah Financial District	28,000	62%	
Housing Faculty in King Saud University	2,182	77%	Public services and housing
Housing Project	2,512	4%	
King Abdulaziz National Dialogue Center	300	70%	

Table 2.1: Constriction Projects in Riyadh City (HCD, 2014)

2.8.3 Significance of Building Maintenance

The significance of the maintenance sector in the economy is obvious from the size of the construction projects shown in Table (2.1). Clearly, such construction projects imply enormous maintenance costs and place the BM industry under great pressure to perform more efficiently than before the construction boom.

As already mentioned in the previous sub-section, the Annual Report of the High Commission for Development of Riyadh City (HCD) cites the operation and maintenance cost at SR 10 billion in 2014. These costs are essentials if economic and social development is to be assured, as it is known that the inadequacy of the operation and maintenance of building and infrastructure in developing countries has serious consequences on such development (Chanter and Swallow, 2007). Nevertheless, maintenance services are perceived as non-core service activities in most public organisations in Saudi Arabia, and hence, maintenance services are usually outsourced to contractors who specialise in maintenance (KACST, 2012). In this respect, the Fourth National Development Plan included the need to offer the private sector the opportunity to operate and maintain public utilities and facilities, wherever this proved to be economically feasible. The inclusion of the private sector in this way demonstrated that finance for maintenance was not perceived to be an issue by the government.

Fixed-price contracts for public maintenance works are awarded to private sector contractors on a competitive basis as required by statutory law, and usually a project is awarded to the lowest bidder. During the Seventh National Development Plan (2005-2009), about 10,000 contracts, totalling in excess of SR 150 billion, were awarded by the various ministries, corporations, and government agencies (Ibn-Homaid, 2006). The lowest bidder typically tries to complete work at the lowest possible cost, in order to generate maximum profit from the project (Assaf *et al.*, 1998), but not surprisingly, this approach adversely affects the quality of the maintenance work performed.

The diversity of the contractual methods and work types makes the maintenance contracting system a complex one. It also leads to significant variation in the amounts stated in tenders. In most cases a contract includes all three maintenance types: work orders, emergency maintenance, and preventive maintenance. Normally, the owner's maintenance department supervises workflow and requires the contractor to submit a

monthly report regarding work progress (Al-Arjani, 1995). The majority of maintenance contractors operate and maintain public buildings through foreign labour ranging from highly skilled to unskilled. However, unskilled labourers represent the majority. They are paid low wages and came from countries with high-unemployment such as Pakistan and India. As a consequence, local nationals have abandoned working in the operations and maintenance industry because it has become dominated by foreign labour. Not surprisingly, the Saudi BM industry is faced with a number of challenges because of these structural characteristics, and these are discussed in the next section.

2.9 Challenges Facing the Saudi Maintenance Industry

In Saudi Arabia the management procedures adopted by maintenance contractors are poor and result in low quality operation. Previous studies, such as that by Talal (1995), attempted to create a standardised maintenance contract by collecting essential information from a number of government offices around the Kingdom, after studying available public building maintenance contracts. Other studies by Tawfieg (1994), and Ahmad (1995) explored the obstacles faced by the maintenance industry, and the effect of such obstacles on development in Saudi Arabia. In another study by Ikhwan *et al.* (1995), the importance of maintenance in the Kingdom was highlighted, and the need for proper education in the realm of maintenance was discussed. And in studies by Al-Hussayien (1980), Al-Hammad *et al.* (1995), and Arafah *et al.* (1995) a variety of factors contributing towards inefficiency and ineffectiveness in the BM industry were identified, such as: the absence of laws and regulations, the use of foreign standards, personal judgments employed without reference, unavailable or poorly-written operational maintenance manuals, lack of co-ordination between the construction and maintenance group, poor classification of maintenance contractors, and lack of uniform maintenance. Ikhwan *et al.* (1995) recommended an extensive assessment of the current states of maintenance management and practice in the Kingdom, and also more university-industry interaction in the field of maintenance.

Clearly, some research on maintenance management and practice in the Kingdom has been undertaken, very few articles focus on sound scientific solutions to maintenance problems, and hence, the available literature is extremely limited in its focus and range. However, with recent developments and research in maintenance industry, there is a great opportunity to investigate how QMCs can assist in managing BM sector. Furthermore, the

research by Mansour (1990) had discussed the manpower requirements for operations and maintenance in Saudi Arabia, and much more recently, Hassanain and Al-Saadi (2005) addressed the system of classifying maintenance contractors. The prevailing difficulties can be seen to result from the fact that Saudi Arabia has no uniform maintenance standards or specifications for maintenance activities. Hence, maintenance work is characterised by poor quality. In Saudi Arabia no research was found that focused specifically on implementing QMCs in the BM industry.

From the previous sections, the researcher developed a conceptual BM diagram based on the literature reviewed and based on the process used by the researcher's previous employers, to be used as a starting point in the interviews (see Figure 2.8). The idea behind this method was to develop a generic BM diagram that represents main activities followed by the BM departments. this conceptual BM diagram was presented to the interviewees and they were asked to modify the diagram to figure out the developed BM process, as shown in (Figure 5.3), consists of the main BM parties and the type of activities and processes that are conducted (arrows linking these boxes).

This study will develop a validated generic BM diagram. Undoubtedly, the issue of quality management in the maintenance industry is of concern, and next section will discuss the poor quality in BM practice and the need to improve the BM industry through implementation of QMCs.

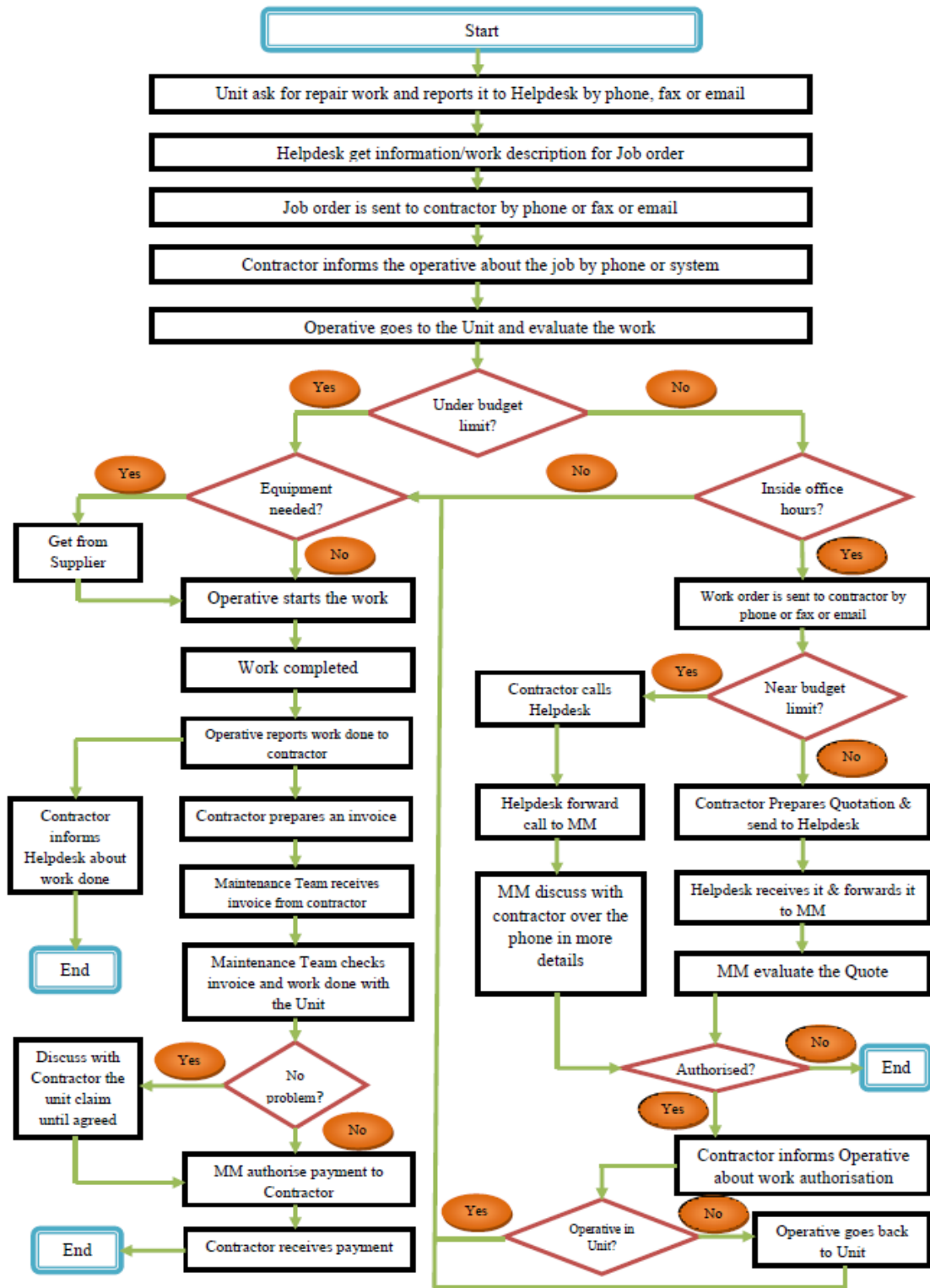


Figure 2.8: The Conceptual BM Diagram

In brief, the QMC chosen should incorporate design and maintenance policies, planning, management responsibility, design and maintenance input/output requirements of maintenance details, evaluation of design and installation, control and review (including

feedback), planning and management of inspection/testing and commissioning for compilation of O&M manuals and review of performance. There are indications that maintenance is beginning to receive closer attention than formerly, and hence, improvements should be forthcoming. In this environment a QMC can represent a rational solution to managing building services maintenance, as is discussed in the next chapter.

2.10 Summary

This chapter has reviewed the literature related to BM, highlighting how this is defined, the different types and processes which are seen in the maintenance function, the players involved, and the general challenges facing BM. Specifically, the status of BM in Saudi Arabia has been explored within the context of the Saudi economy, and its construction industry. The significance of BM has been considered, and an overview of the current Saudi maintenance departments' practice is provided, together with the problems facing the Saudi maintenance industry. The potential of QM as a solution to some of these problems has also been highlighted. The researcher developed a conceptual BM diagram based on the literature reviewed, to be used as a starting point in the interviews.

What has emerged from the overall discussion in the chapter is the fact that in order to develop and implement good maintenance, it is necessary to thoroughly understand the business process of BM management, yet the literature does not feature any studies investigating BM processes in the Saudi context, although it is clear that several commercial and research-based applications have been proposed to manage the BM process in other countries.

Additionally, it is clear that QM offers opportunities for improvement in operations and maintenance. Consequently, the next chapter considers five different QMCs, namely (Total Quality Management - TQM, Six Sigma, Lean Management, Lean Six Sigma, and the International Organisation for Standardization [ISO] series of standards), since these are all concepts that have been applied by many different organisations to improve performance.

Chapter 3: Quality Management Concepts

3.1 Introduction

Quality management is defined and measured in empirical studies as the practices and measures incorporated by an organisation that implement principles such as customer focus, continuous improvement, and team work to improve the product and service quality (Zu, 2009). Deming defines quality as “*continuous improvement*” (Kerzener, 2009).

During the last decades, different quality management concepts (QMCs), including Total Quality Management (TQM), Six Sigma, Lean Management, Lean Six Sigma, and the International Organisation for Standardisation (ISO) series of standards, have been applied by many different types of organisation to improve business performance. This chapter provides an in-depth review of the existing body of literature concerning these QMCs in the construction and maintenance industry. In undertaking this review, it is noted that all these QMCs have been generated in developed countries and have different orientations. Consequently, a number of questions remain concerning the applicability of these concepts in developing countries, and in particular organisational settings that have not yet been investigated. The BM industry is one such context, and Saudi Arabia as a developing country, provides yet another new dimension.

The purpose of this chapter is, therefore, to assess the similarities and differences between the concepts, comparing their definitions, methodologies, tools, application and evaluation procedures, and now they are used in various industries. This is done in an attempt to identify which particular concept is most suitable and effective to the BM process and to the Saudi environment. The following sections provide an overview of each of these five QMCs.

3.2 Total Quality Management

Many authors have provided definitions and clarifications of the concept of TQM. According to Lassaad *et al.* (2006) TQM is generally described as a collective, interlinked system of quality management practices that are associated with organisational performance. Hellsten and Klefsjo (2000:211) define TQM as “*a continuously evolving management system consisting of values, methodologies and tools, the aim of which is to increase external and internal customer satisfaction with a reduced amount of resources*”.

TQM permeates the culture of an organisation and also supports the effort to achieve customer satisfaction by the integration of a system of tools, techniques and training. It includes the continuous upgrading of organisational processes such that high quality products and services can be delivered (Low, 1996). The British Standards Institution BS 5750 defines TQM as: “*The management philosophy and organization practices that aim to harness the human and material resources of an organization in the most effective way to achieve the objectives of the organization*”. Ho (1995) stresses the fact that all levels of management should support the improvement of products and services, and that customers and suppliers should also be involved.

Based on these definitions, it can be understood that TQM is top-down management philosophy focused on monitoring process, employee involvement, and continuous quality improvement in order to meet customer needs. It can also be appreciated that TQM involves all people in all functions, and at all levels (Low, 1996)

3.2.1 TQM Principles

The principles of TQM involve the need for, and use of, a number of distinct generic practices, which are shown in Table 3.1. For each generic practice, a list of similar practices proposed by other authors is provided.

Practice	Related practices
Top management commitment and support	Top management commitment (Ahire <i>et al.</i> , 1996; Powell, 1995; Tamimi, 1998), top management team involvement (Douglas and Judge, 2001), leadership (Anderson and Sohal, 1999; Sun, 2001; Zhang <i>et al.</i> , 2000)
Organization for quality	Quality management design (Ahire <i>et al.</i> , 1996), open organization (Powell, 1995), cross-functional teams (LaHay and Noble, 1998), control and improvement of processes (Zhang <i>et al.</i> , 2000)
Employee training	Training (Saraph <i>et al.</i> , 1989), education and/or training (Ahire <i>et al.</i> , 1996; Kannan <i>et al.</i> , 1999; Powell, 1995; Tamimi, 1998; Zhang <i>et al.</i> , 2000), emphasis on TQM-oriented training (Douglas and Judge, 2001)
Employee participation	Participation (Zhang <i>et al.</i> , 2000), delegation (Ahire <i>et al.</i> , 1996; Powell, 1995), employee involvement (Ahire <i>et al.</i> , 1996), employee relations (Saraph <i>et al.</i> , 1989)
Supplier quality management	Supplier quality management (Ahire <i>et al.</i> , 1996; Saraph <i>et al.</i> , 1989; Zhang <i>et al.</i> , 2000), supplier management (Tamimi, 1998), suppliers (Najmi and Kehoe, 2000; Sun, 2001), supplier relations (Forza and Filippini, 1998; Powell 1995)
Customer focus	Customer focus (Ahire <i>et al.</i> , 1996; Anderson and Sohal, 1999; LaHay and Noble, 1998; Zhang <i>et al.</i> , 2000), strong relations with customers (Powell, 1995), customer satisfaction (Forza and Filippini, 1998), customer driven (Douglas and Judge, 2001)
Continuous support	Continuous improvement (Douglas and Judge, 2001), recognition and rewards (Zhang <i>et al.</i> , 2000)
Quality system improvement	Quality system improvement (Zhang <i>et al.</i> , 2000)
Information and analysis	Information and analysis (Anderson and Sohal, 1999; Choi and Eboch, 1998), information (Sun, 2001), information flow (Kannan <i>et al.</i> , 1999), quality information system (Najmi and Kehoe, 2000), process measurement (LaHay and Noble, 1998), use of internal information on quality (Ahire <i>et al.</i> , 1996), Quality data (Saraph <i>et al.</i> , 1989), measurement of quality (Powell, 1995), benchmarking (Ahire <i>et al.</i> , 1996; Powell, 1995)
Statistical quality techniques use	Use of statistical procedure (Ahire <i>et al.</i> , 1996), total quality methods (Douglas and Judge, 2001)

Table 3.1: Links between Practice and Related Practice (Source: Lassaad, 2006, pp.625-646)

Flynn et al. (1995), Pannirselvam and Ferguson (2001), and Sousa and Voss (2002) (cited in Lassaad, 2006) categorised these generic practices into three main groups (see Table 3.2) as follows:

1. **Management practice:** Management issues related to the top level; issued from the top management;
2. **Infrastructure practices:** Supports for the core practices; intended to facilitate the use of core practices; and
3. **Core practices:** Practices at the heart of the organisation; these depend on the tools and techniques available, and are closely related to quality.

Management practice	Infrastructure practices	Core practices
Top management commitment and support	Organization for quality Employee training Employee participation Supplier quality management Customer focus Continuous support	Quality system improvement Information and analysis Statistical quality techniques use

Table 3.2: Classification of QM Practices (Source: Lassaad, 2006, pp.625-646)

The critical factors may differ according to which of the procedures are used and also how they are introduced. Nonetheless, the most commonly agreed-upon factors are still commitment at the top level of management, focus on customers, good quality of data and information, stress on the involvement of employees, and importance of employee training.

3.2.2 Awareness Levels of TQM Implementation

There are different levels at which TQM can be implemented within the organisation, but an appreciation of these levels can only be achieved when TQM has been agreed as a suitable management system for that organisation. According to Chin and Pun (2001), there are five such levels at which TQM can be introduced, and these are described as: Unaware, Uncommitted, Initiator, Improvers, and Achievers as shown in Figure 3.1.

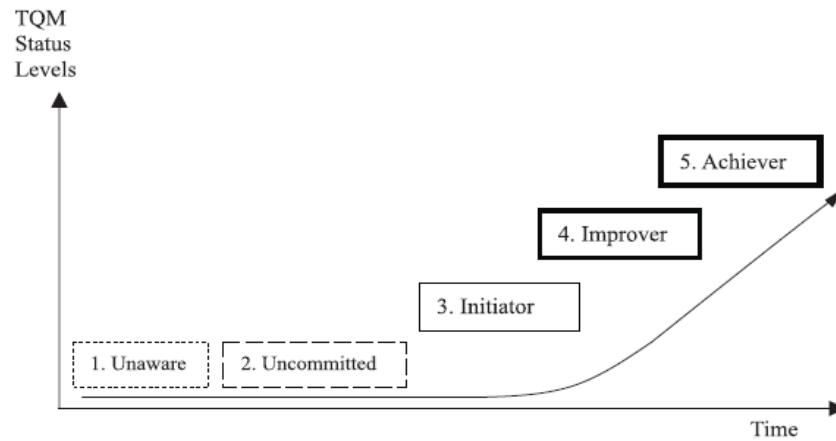


Figure 3.1: Five-level Assessment of TQM Implementation (Source: Chin and Pun, 2001, pp.272-294)

Each of the levels of awareness in Figure 3.1 is scored (0, 1, 2 and 3) to provide an evaluation of the current implementation status of an organisation. The final score gives an indication of the stage attained by the organisation in respect of its TQM implementation (see Table 3.3).

Score	TQM adoption level
≥ 70	Achiever
≥ 40 but < 70	Improver
≥ 20 but < 40	Initiator
< 20	Unaware/uncommitted

Table 3.3: A Self-assessment Scoring Scheme of TQM Implementation (Source: Chin and Pun, 2001, pp.272-294)

Lascelles and Dale (1991), on the other hand, suggest a six-level model of implementation awareness, including a level which introduces the notion of quality awards. These awards act as a catalyst in encouraging their recipients to continue to produce commendable work, and simultaneously serve as inspiration for others to strive for the same quality of output. Many companies have been motivated by this award criterion to work towards complete implementation of TQM across their branches, whether local, regional, national or international. Examples of such international quality awards are the European Quality Award, and the Swedish Quality Award; and in Saudi Arabia, there is the King Abdul Aziz Quality Award (KAAQ), established to honour the organisation with the best practice internationally, and the best understanding of the local business environment. The KAAQ was introduced in the year 2000 to support the public and private sectors. It enables them

to compete globally by using principles and practices which help them to meet customer expectations. That said, it is noted that none of the public organisations have won this award since 2000.

Lam (2000) argues for the implementation of TQM in organisations on the basis that it ensures their effective performance and functioning, since it facilitates the smooth operation of the innumerable activities and functions that are by nature interlinked. Using TQM it is possible to identify and relate these activities such that the input is effectively converted into output and that during this entire process, quality is properly managed and maintained.

3.3 Six Sigma

Six Sigma represents another quality improvement strategy which is known to be successful in businesses, and this section presents a definition of this concept, the principles, methodology, applications, and critical success factors associated with its use. The results of an extensive literature review on Six Sigma revealed that much of the written evidence on issues such as implementation concentrates on positive attributes (Nonthaleerak and Hendry, 2006) which are readily observed. Hence, for the construction industry with its reputation of suboptimal performance, Six Sigma if properly implemented can lead to welcome outcomes (Tutesigensi and Pleim, 2008).

3.3.1 Definition of Six Sigma

Six Sigma is defined: as “*a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction by some of its proponents*” (Magnusso et al., 2003:135). It is a structured methodology that has found wide acceptance in the manufacturing sector by such firms as General Electric, and Motorola. In essence, the principles of Six Sigma have been derived from TQM theory. However, its structured and systematic framework, combined with the employment of statistical techniques, makes it an excellent tool for process diagnostics, which is an integral task of modern construction managers (Stewart and Spencer, 2006).

The purpose of Six Sigma is to reduce cost by minimising the variability in processes, thus leading ultimately to fewer defects. Six Sigma is also hailed as a method to reduce waste,

increase customer satisfaction, and improve financial results (Revere et al., 2003). By its use of statistical methods, Six Sigma allows organisations able to understand fluctuations in a process, which then enables them to pinpoint the cause of a problem.

Antony and Banuelas (2002) define Six Sigma from both a business and statistical perspective. From a business perspective, they describe it as a strategy used to improve profitability, reduce quality costs, and improve overall operations to exceed the customer's expectations. In statistical terms, Six Sigma refers to 3.4 defects per million opportunities (DPMO), where sigma represents the variation in the process average.

In general, the above definitions of Six Sigma may be summarised to reflect the following two aspects:

- Six Sigma is a statistical measure used to measure the performance of processes or products against customer requirements. This is known as the 'technical' definition of Six Sigma; and
- Six Sigma is a 'cultural and belief' system and a 'management philosophy' that guides the organization in repositioning itself towards world-class business performance by increasing customer satisfaction considerably and enhancing bottom lines based on factual decision-making.

The primary objective of the Six Sigma methodology is the implementation of a measurement based strategy, which focuses on process and sub-processes improvement through the application of Six Sigma best practice such as DMAIC and DMADV. The Six Sigma DMAIC (Define, Measure, Analyse, Improve, Control) method is applied when improving existing processes and looking for incremental improvement, whereas the Six Sigma DMADV (Define, Measure, Analyse, Design, Verify) method is applied when developing new processes or products at Six Sigma quality levels (Antony, 2006).

Six Sigma is not just a way of measuring the level of quality, but also one of determining weaknesses and establishing where the organisation could do better, and hence serve the customer better (Antony, 2006; Antony et al., 2007). It is a means of instilling in the people within the organisation, a new perspective on what is acceptable (Nakhai and Neves, 2009). While the major benefit of the system may be its impact on the bottom line,

there are many other advantages to its adoption such as increased customer satisfaction, higher understanding of problem-solving, increased teamwork, and increased employee morale (Chakrabarty and Tan, 2007).

3.3.2 Six Sigma Principles

The principles of Six Sigma can be divided into the following six themes (Pande et al., 2000; Pande and Holpp, 2002):

1. ***Genuine focus on the customer.*** While profits and statistical tools seem to attract the most publicity, the emphasis on customers is the most remarkable element of Six Sigma.
2. ***Data and fact-driven management or metrics for decision-making.*** *Six Sigma* takes the concept of ‘management by facts’ to a new and more powerful level. Instead of basing business decisions on opinions and assumptions, Six Sigma builds the foundation of decision-making by using metrics (i.e., numbers in building up key measures that represent and calculate the success of everything an organisation does).
3. ***Process focus, management, and improvement.*** Six Sigma positions the process as the key vehicle of success.
4. ***Proactive management.*** Proactive means action in advance of events rather than reacting to them. An example of proactive management in Six Sigma is the focus on eliminating defects at the source instead of trying to manage a defect or a problem after it has occurred.
5. ***Boundless collaboration.*** Boundless means working to break down corporate barriers and to improve teamwork up, down, and across organizational lines.
6. ***Drive for perfection, tolerate failure.*** Although these two ideas sound contradictory, they are actually complementary. The bottom line is that for any company that applies Six Sigma its goal will have to continually rise in order to become more perfect, yet the company will also have to be willing to accept and manage occasional setbacks.

3.3.3 Six Sigma Methodology and Implementation

There are several models that can be used in the implementation of Six Sigma in an organisation, for example, the five-phase improvement cycle that has become increasingly common in Six Sigma organisations: define, measure, analyse, improve, and control (DMAIC) (Pheng and Hui, 2004) (see Figure 3.2). The steps involved are:

1. **Define:** Define the customers, their requirements, the team charter, and the key processes that affect the customers. Goals and/or objectives of a certain process are then set based on the customer's requirements.
2. **Measure:** Identify the key measures, the data collection plan or the plan for measurement of the process in question, and execute the plan for data collection.
3. **Analyse:** Analyse the data collected as well as the process to determine the root causes of the problem that need improvement.
4. **Improve:** Generate and determine the potential solutions and plot them on a small scale to determine if they positively improve the process performance. Successful improvement methods are then implemented on a wider scale.
5. **Control:** Develop, document, and implement a plan to ensure that performance improvement remains at the desired level.

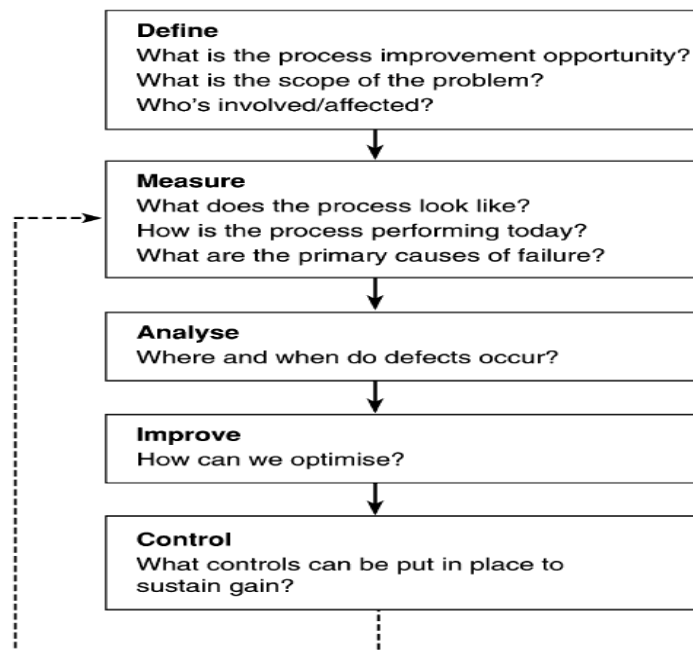


Figure 3.2: Six Sigma's Structured Methodology (DMAIC) (Source: Stewart and Spencer, 2006)

The backbone of the Six Sigma methodology is the well-known five steps of the DMAIC process (Tutesigensi and Pleim, 2008). However, the critics of Six Sigma often claim that the DMAIC methodology is not fundamentally different from the methodologies of other quality movements, such as Deming's plan-do-check-act cycle by guiding (Nakhai and Neves, 2009).

3.3.4 Key Elements of Successful Six Sigma Implementation

- ***Management involvement and organisational commitment***

Six Sigma requires top management dedication and contribution to resources and effort, and in this respect it can be seen that CEOs are often involved in the implementation process. The organisational infrastructure needs to be established with well-trained individuals ready for action. This implies the commitment of resources, time, money, and effort from the entire organisation (Kwak and Anbari, 2006).

- ***Encouraging and accepting cultural change***

People facing cultural change and challenges due to the implementation of Six Sigma must first understand the change that is to be implemented, and this requires that the organisation have a clear communication plan and channels, motivate individuals to overcome resistance, and educate senior managers, employees, and customers on the benefits of Six Sigma. Announcing the results of Six Sigma projects, including successes, obstacles, and challenges will help to avoid the repetition of similar mistakes and encourage the adoption of only the very best practices.

- ***Continuous education and training***

Education and training enable people to better understand the fundamentals, tools, and techniques of Six Sigma. Training is essential to the communication of information to make sure that managers and employees apply the complex Six Sigma techniques effectively; the identification of expertise possessed by employees is inherent in the belt system (Hoerl, 2001).

3.4 Lean Management

The emergence of the Lean management concept during the 1990s came after an innovation within the construction industry which had a positive effect through time. Through the concept of waste elimination and value enhancement in a construction project, it was seen that project activities could be undertaken in a systematic and effective manner. The direct application of the Lean Construction concept in a building project greatly affects the work conducted by an organisation for the better (Abdullah et al., 2009).

Many people consider lean thinking as a manufacturing technique imported by the construction industry. Indeed one response to the argument that construction is different, and hence could not benefit from the approach, is to consider that construction can be viewed like manufacturing if greater standardisation is evident. The principle of lean management redefines performance against three dimensions of perfection:

1. A uniquely customised product, that is
2. Delivered instantly, with
3. Nothing in stores.

Lean production is a value-seeking process that maximises value and continually redefines perfection. Moving toward this form of perfection requires more than a change in procedure; rather it needs a change in the way construction is thought about and done (Howell and Ballard, 1998). This section provides an overview of lean management, lean barriers, and lean implementation.

3.4.1 Lean Definitions

Lean production is currently a buzz phrase in many manufacturing industries (Fellows et al., 2002), and some in the construction sector have tried to adapt it. The proponents of lean construction argue that it has the potential to tap into new and existing production theories dedicated to minimising wasteful activities. It has the goal of better meeting the customers' needs while minimising waste and using fewer resources (Dunlop and Smith, 2004; Alinaitwe, 2009).

The International Group for Lean Construction (IGLC) has led research on the application of lean techniques in the construction industry and has provided tools for operational planning and control, supply, visualisation, and continuous improvement (Koskela, 2002). The word 'lean' was defined by Howell (2001) as a process which gives customers what they want, instantly, and with no waste involved. The lean construction experience developed by Toyota is, for many people, regarded as the only path for the building industry. Lean construction concepts have recently received attention as a modern way to improve construction performance and labour productivity (Abdel-Razek et al., 2007).

Womack and Jones (1994) define lean as the systematic removal of waste by all members of the organisation from all areas of the values stream. It is often referred to as a cost-

reduction mechanism (Achanga, 2006; Bicheno, 2004). Lean strives to make organisations more competitive in the market by increasing efficiency and decreasing costs by eliminating the non-value-adding (VA) steps and inefficiencies in the processes (Motwani, 2003), as well as by reducing cycle times (Sohal and Egglestone, 1994), and increasing profit for the organisation (Claycomb et al., 1999).

Lean management forces attention on how value is generated rather than on how any one activity is managed. Whilst current project management views a project as the combination of activities, lean thinking views the entire project in production system terms, as one large operation. It is difficult to optimise a large production system in construction (a project) because of the complex interaction between the parts (Howell and Ballard, 1998). Every production system integrates the design and manufacture of a product. Production (and hence, project) management is understood in terms of designing, operating, and improving production systems (Koskela, 2001).

3.4.2 Lean Methodology

One common measure is touch time, the amount of time the product is actually being worked on, or touched, by the worker. Frequently, the focus of lean is manifested in an emphasis on flow. There are five essential steps in lean, which are to:

1. Identify which features create value,
2. Identify the sequence of activities called the value stream,
3. Make the activities flow,
4. Let the customer pull product or service through the process, and
5. Perfect the process.

Identify value. The determination of which features create value in the product is made from the internal and external customer standpoints. Value is expressed in terms of how the specific product meets the customer's needs, at a specific price, at a specific time. Specific products or services are evaluated on which features add value. The value determination can be from the perspective of the ultimate customer or a subsequent process.

Identify the value stream. Once value is identified, activities that contribute value are identified. The entire sequence of activities is called the value stream. Then a determination is made as to whether activities that do not contribute value to the product or service are necessary. Necessary operations are defined as being a prerequisite to other value added activities or an essential part of the business. An example of a non-value added but necessary process is payroll. After all, people need to be paid. Finally the impact which non-value added activities have on the process is reduced to a minimum. All other non-value added activities are transitioned out of the process.

Improve flow. Once value added activities and necessary non-value activities are identified, improvement efforts are directed toward making the activities flow. Flow is the uninterrupted movement of a product or service through the system to the customer. Major inhibitors of flow are work in queue, batch processing, and transportation. These buffers slow the time from product or service initiation to delivery. Buffers also tie up money that can be used elsewhere in the organisation and cover up the effects of system restraints and other wasted activities.

Allow customer pull. After waste is removed and flow established, efforts turn to letting the customer pull product or service through the process. The company must make the process responsive to providing the product or service only when the customer needs it - not before, and not after.

Work toward perfection. This effort is the repeated and constant attempt to remove non-value activity, improve flow, and satisfy customer delivery needs. While lean focuses on removing waste and improving flow, it also has some secondary effects. Quality is improved, the product spends less time in process, reducing the chances of damage or obsolescence, and simplification of processes results in the reduction of variation. As the company looks at all the activities in the value stream, the system constraint is removed, and performance is improved. The lean methodology also makes the following assumptions:

- People value the visual effect of flow.
- Waste is the main restriction to profitability.

- Many small improvements in rapid succession are more beneficial than analytical study.
- Process interaction effects will be resolved through value stream refinement.
- People in operations appreciate this approach.
- Lean involves many people in the value stream.

Transitioning to flow thinking causes vast changes in how people perceive their roles in the organisation and their relationships to the product (Nave, 2002)

3.4.3 Lean Construction and its Barriers

Four main factors are known to constrain the application of the lean construction concept, these being:

- Lack of attentiveness and commitment from top management,
- Difficulties in understanding the concept of lean construction,
- Lack of proper training, and
- The tendency of construction firms to apply traditional management concepts as opposed to productivity and quality management concepts (Abdullah et al., 2009).

According to Alarcon et al. (2002), research findings by the Production Management Center (GEPUC) from the Catholic University of Chile, has shown that the application of the lean construction concept in the industry has faced problems pertaining to:

1. **Time:** the main difficulty in the implementation, according to the participants, was the lack of time for implementing new practices in the projects that were already under way.
2. **Organisation** to respond adequately to the challenge of implementing the lean construction, it was necessary to create or fortify some organisational elements.
3. **Lack of Self-Criticism:** the lack of self-criticism limited the capacity to learn from errors since only part of the problem was perceived. In addition to understanding the barriers experienced during the work, it was also necessary to respond to some deficiencies of the implementation on some projects.
4. **Low understanding of the concepts of lean construction:** (production units, work flow, screening, shielding, pulling).

5. ***Low use of the different elements of lean construction:*** (Make ready, formation of Workable Backlog, and taking corrective actions).
6. ***Inadequate administration of the necessary information*** to generate a 'learning cycle' and to take corrective actions.
7. ***Weak communication and transparency*** among participants in the production process (managers, administrators, foremen, etc.).
8. ***Lack of integration of the production chain:*** (client, suppliers of materials, sub-contractors).

Additionally, Forbes and Ahmed (2004) have stated that there are various hurdles in the way of efforts to inculcate the concept of lean construction. These obstacles refer to attitude, roles, relationships, actions, and communications among the respective parties involved in the construction industry such as the contractors, sub-contractors, and the client/owner.

3.4.1 Lean Concepts in Construction

Implementing lean concepts means applying tools and techniques throughout the stages of a project. A theoretical foundation is provided through the transformation flow-value view and further aspects of management theory and complexity theory. It seems, however, that the implementation of lean concepts requires a fundamental change to traditional structures in terms of both organisation and behaviour.

Lean concepts have been brought to the construction industries of Australia, Brazil, Denmark, Ecuador, Finland, Peru, Singapore, UK, USA, and Venezuela (Ballard and Howell, 2003a). However, surveys in the UK (Common et al., 2000) and the Netherlands (Johansen et al., 2002) strongly suggest that the construction industry has generally been slow in taking up lean concepts. A comparison of the surveys also reveals that the two countries differ in their approach to lean construction (Johansen et al., 2002). With regard to the German construction industry, there is little, if any, information available about the range and dissemination of lean concepts among construction companies. In Malaysia, the use of the lean construction concept in the industry is still considered to be new and novel. According to Johansen and Walter (2007), the application of the lean concept in the construction industry is still restricted and sluggish. Following this it was stressed that some of the countries where lean concepts have successfully been implemented (e.g.

Brazil or Chile) are employing more workers and using less technology than before. Thus, it could be argued that lean construction is more effective when implemented in countries which are more people-focused than technology-focused. However, this argument would need verification since major improvements have been achieved with lean construction in technology-driven countries like Australia, Denmark and the USA.

Lean construction is a concept that incorporates several other concepts from the construction management industry. These concepts include Total Quality Management (TQM), Last Planner System (LPS), Business Process Re-engineering (BPR), Concurrent Engineering (CE), Product Circles (PCs), and teamwork and value-based management (Harris and McCaffer, 1997). The key concepts are depicted in Figure 3.3. Most of these concepts are interrelated and all aim to improve performance while minimising waste.

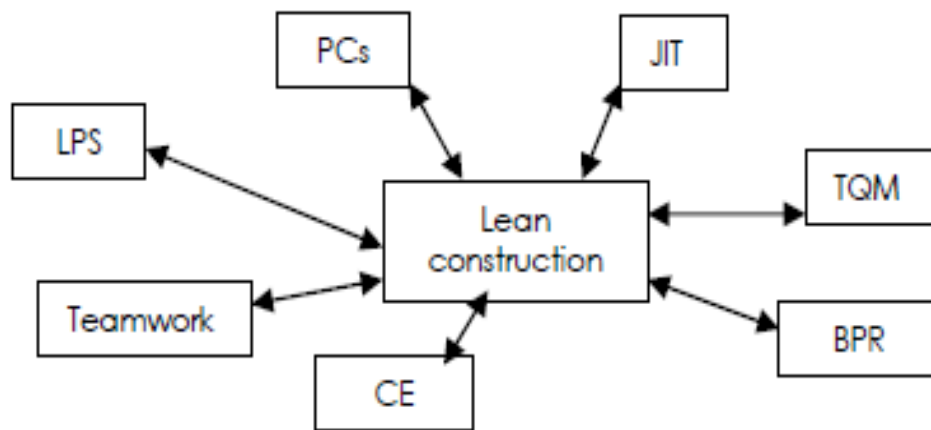


Figure 3.3: Key Concepts of Lean Construction (Source: Alinaitwe, 2009)

3.5 Lean Six Sigma

A combination of two time-tested programmes for achieving operational excellence in major companies is helping leaders discover innovation opportunities and promote a company-wide culture with an inclination toward innovation. It is called a Lean Six Sigma approach or sometimes just Six Sigma. Such a programme is not only about doing things better, but also about doing better things. Used effectively it can enhance innovations in products, services, markets and even a company's underlying business model, as well as improve operations (Byrne et al., 2007).

The majority of Lean Six Sigma applications have been in private industry, focusing mostly on manufacturing applications, although the literature has provided a few cases of Lean Six Sigma programmes applied in the service industry (Furterer and Elshennawy, 2005).

3.5.1 Lean Six Sigma Definition

Lean Six Sigma is an approach focused on improving quality, reducing variation, and eliminating waste in an organisation. It is based on the concept of combining two improvement programmes, Six Sigma, and Lean Enterprise.

As discussed already, Six Sigma is a QM philosophy and a methodology that focuses on reducing variation, measuring defects, and improving the quality of products, processes and services. Lean is a methodology that focuses on reducing cycle time and waste in processes. Six Sigma uses the DMAIC problem-solving approach, and a wide array of quality problem-solving tools. Use of the tools varies based on the type of process studied and the problems that are encountered. There are many tools in the Lean tool set that help to eliminate waste, organise, and simplify the work processes (Furterer and Elshennawy, 2005)

The Lean Six Sigma philosophy builds on the knowledge, methods, and tools derived from decades of operational improvement research and implementation, and is depicted in Figure 3.4.

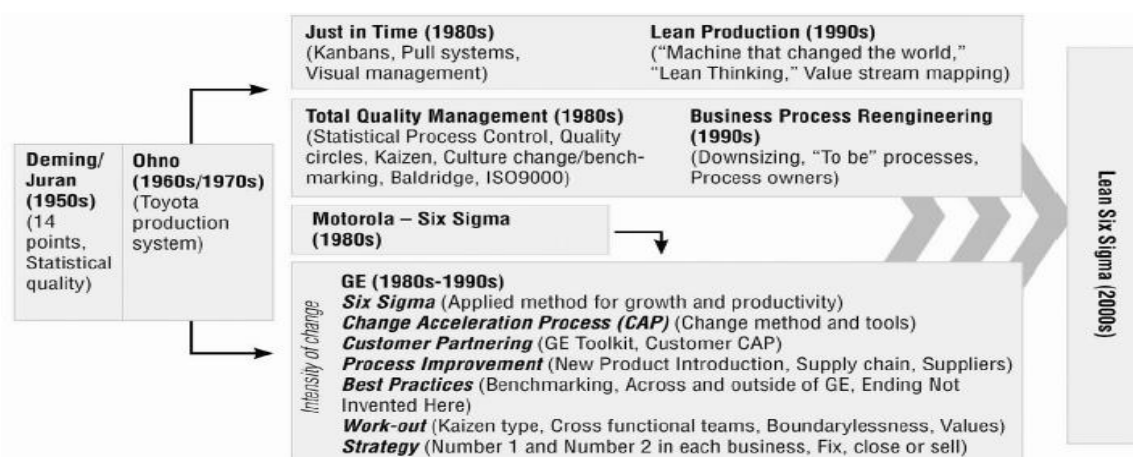


Figure 3.4: Lean Six Sigma builds on the practical lessons learned from previous eras of operational improvement (Source: Byrne et al., 2007)

As mentioned already, the phrase Lean Six Sigma is used to describe the integration of Lean and Six Sigma philosophies (Sheridan, 2000). However, there is little literature available on the integration of these concepts to help researchers looking for a “*common model, theoretical compatibility or mutual content or method*” (Bendell, 2006:68). This confirms that the concept of Lean Six Sigma as an approach to process improvement has yet to fully mature into a specific area of academic research (Bendell, 2006). It can be said that in practice the majority of efforts to fully and comprehensively implement a Lean Six Sigma initiative to its full potential have not been realised (Smith, 2003). Six Sigma complements Lean philosophy in as much as providing the tools and know-how to tackle specific problems that are identified along the lean journey: “*Lean eliminates ‘noise’ and establishes a standard*” (Wheat et al., 2003:44). Six Sigma focuses on the identified variation from the proposed standard, which in itself does not entirely concentrate on the customer requirements; instead it is sometimes a cost-reduction exercise (Bendell, 2005) that can lose sight of the customer if not implemented alongside Lean. Similarities can again be drawn between Lean and Six Sigma, and the need for a culture of continuous improvement operating at all levels within an organisation. Arnheiter and Maleyeff (2005) take this discussion further in their work on the integration of Lean and Six Sigma, and outline the benefits of such a consolidated approach. For example, this provides Lean with a more scientific approach to quality, so that through the use of control charts, processes can be kept on target, effectively reducing waste incurred through faulty processing.

Lean techniques are also used to consider and improve the organisation’s performance at operational levels, reducing complexity and interactions within the system, through the targeted removal of non-value adding activities. From this reduction in complexity, Lean identifies opportunities for improvement that can then be leveraged through the application of high powered and more Six Sigma techniques, driving the improvement of the system further towards a Lean environment.

Kumar et al. (2006), have integrated some key Lean techniques with a Six Sigma framework for an Indian SME. The approach taken was to develop a Lean Six Sigma framework around the problems identified in the organisation, which, while effective, may well be beyond the reach of most practitioners working under strict time and other resource constraints. The key points made from this work are:

- There is no standard framework for Lean Six Sigma;

- There is no clear understanding concerning the usage of tools, etc., within the Lean Six Sigma frameworks.

3.5.2 Lean Six Sigma Applications in the Private Sector

The concept of combining Lean Manufacturing and Six Sigma principles began in the middle to late 1990s, and quickly took hold. There are many examples of manufacturing companies implementing a combined effort of Lean and Six Sigma. An early example, starting in 1997, was by an aircraft-engine-controls firm, BAE Systems Controls, in Fort Wayne, Indiana. This company blended Lean-manufacturing principles with Six Sigma quality tools (Sheridan, 2000). Another early innovator combining Lean and Six Sigma was Maytag Corporation, which implemented Lean Sigma in 1999 by designing a new production line using the concepts of Lean and Six Sigma. Additionally, Lean Six Sigma has been implemented at Northrop Grumman, an Aerospace Company, and at Lockheed Martin Aeronautical Systems where reduced costs, improved competitiveness, customer satisfaction, and the first-time quality of all its manufactured goods resulted. Lockheed Martin Aeronautical Systems ran separate Lean and Six Sigma projects, depending on the objective of the project and the problem that needed to be solved (Furterer and Elshennawy, 2005).

3.5.3 Implementation of Lean Six Sigma in Construction

In 2006, the United States Secretary of the Navy released a memorandum entitled Transformation through Lean Six Sigma (LSS), and subsequently, LSS aligned with other practices was implemented by the Naval Facilities Engineering Command (NAVFAC) in their contracts (i.e., design-build and partnering). LSS has had multiple goals and effects on NAVFAC construction projects, namely: reducing litigation and adversarial relationships, reducing costs and delivery time, and improving the buildings and the lives of those who use them. Ultimately, the successful deployment of LSS supports NAVFAC's mission to strengthen Navy and Marine Corps combat readiness worldwide through facilities lifecycle support focused on the Fleet, Fighter, and Family, and serves as an example to institutions with similar roles. However, LSS implementation in construction projects has not been fully deployed yet.

3.6 Quality Management System ISO 9000

Although ISO 9000 was introduced in the late 1980s, its popularity continues today. It is not surprising then that by the end of December 2007, there were at least 951,436 ISO

9001:2000 valid certificates issued to companies worldwide (ISO Survey, 2008). The purpose of the ISO 9000 standards is to assist organisations in all sectors and sizes to implement and operate an effective QMS. Generally, the implementation of ISO 9000 QMS can be divided into five stages:

1. Planning (plan),
2. Documentation (do),
3. Verification and validation (check),
4. Deployment (act) and
5. Continuous improvement (Wahid and Corner, 2009).

The model of ISO 9001:2000 below is a framework of how organization should work in regard to quality and more specifically, what the organization requires to do (Dale et al., 2007). The model shows five principal elements, which each include a set of requirements, actions, and processes. The first element is ‘*continuous improvement of the quality management system*’ (see Figure 3.5), which includes general requirements of a quality management system and documentation requirements. In this element organization are expected to “*establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this international standard*” (BS EN ISO 9001, 2000).

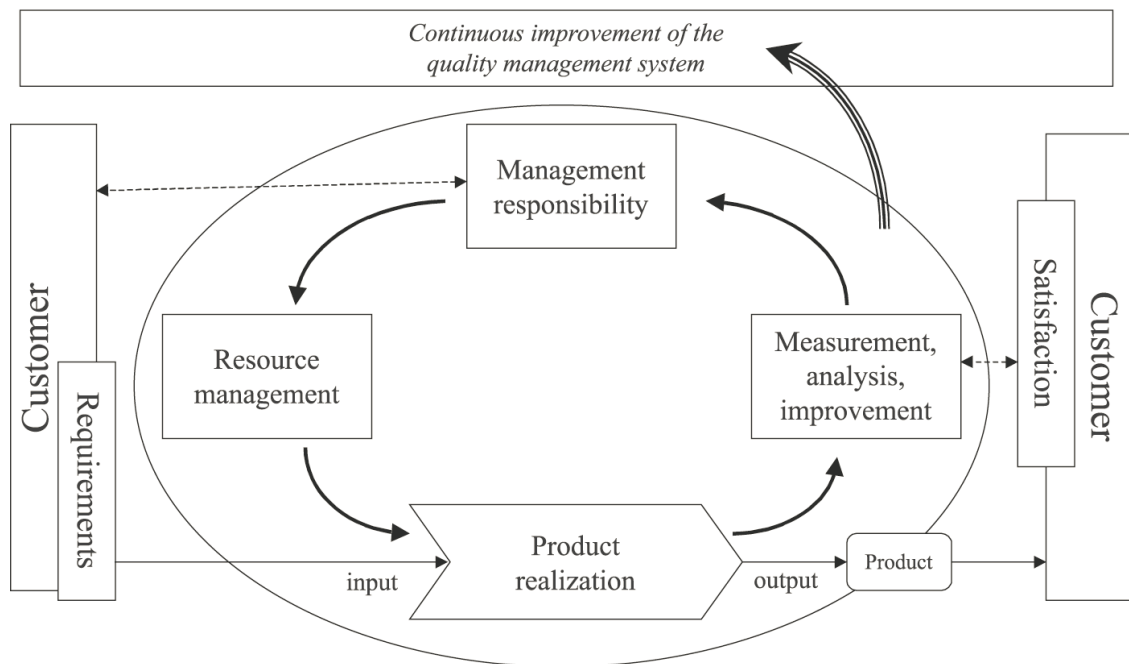


Figure 3.5: ISO 9001:2000 Source: BS EN ISO 9001 (2000)

The second element is '*management responsibility*' and covers the demanded level of management commitment, customer focus, quality policy, planning, responsibility, authority and communication (Dale et al., 2007). The third element of the ISO 9001:2000 framework is '*resource management*' and includes provision of resources, human resources, infrastructure, and work environment (Dale et al., 2007).

The fourth element is '*product realization*' and covers the planning of product realization, customer-related processes, design and development, purchasing, production and service provision, and control of monitoring and measuring devices (Dale et al., 2007). The fifth and last element of the framework is '*measurement, analysis and improvement*'. This element suggests that organizations should "*plan and implement the monitoring, measurement, analysis and improvement processes needed: (a) to demonstrate conformity of the product; (b) to ensure conformity of the quality management system and (c) to continually improve the effectiveness of the quality management system*" (BS EN ISO 9001, 2000).

ISO 9000 is a series of standards dealing with quality systems that can be used for external quality assurance purposes. It sets standards for systems and paperwork (not products) by providing organisations with guidelines on how to establish systems for managing quality products and systems (Barnes, 1998; Bryden, 2004). Registration to the standards demonstrates to customers that the supplying organisation has achieved a basic level of quality assurance by the formalisation and documentation of its quality management system (Beattie and Sohal, 1999). The ISO 9000 family comprises 17 different standards. Out of these 17 only the ISO 9001, ISO 9002 and ISO 9003 are quotable standards, i.e. can be audited against. In fact, some 99% of the ISO registered firms are registered under ISO 9001 or ISO 9002. In terms of the content, ISO 9002 is a sub-set of ISO 9001. The remaining 14 standards are guidelines only (International Organization for Standardization, 2004).

3.7 Quality Management Principles

The ISO 9000 series of standards has been developed on the basis of the eight quality management principles. There are Eight Principles of Quality Management to provide a sound foundation for achieving the organisations goals and objectives. The Eight Principles are articulated below:

- **Customer-focused organization:** Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer requirements. ISO 9001:2008 places much emphasis on customer focus. The means to achieve this may include the conduct of regular customer satisfaction surveys, liaison meetings with representatives of the customers and visits to the operation facilities of the customers. All customer feedback and complaints should be formally recorded and followed up without delay. Details of action taken and recommendations for improvement should be documented. It is also important to give a formal response to the customer before the feedback or complaint is considered "closed".

- **Leadership:** Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives. The implementation of a QMS will hardly be successful if there is lack of commitment from top management. As such, it is critical that top management has a sound appreciation and understanding of all facets of quality management and, in particular, issues pertaining to quality assurance. This understanding and appreciation should be obtained through appropriate training and experience. It must also be remembered that leadership can be found at all levels within an organization and identifying this quality may be of great benefit in establishing a quality culture within a specific section of an organization or throughout the organization as a whole.

- **Involvement of people:** organisation rely of their people and it should ensure they are involved as is appropriate, in the delivery of its services. People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit. Staff must be suitably qualified and competent in their jobs, as the quality of their work directly affects the quality of service. This can be achieved through the provision of appropriate training and evaluation. Quality awareness training should also be provided to all relevant staff to heighten responsibility, accountability and quality consciousness, that is, to assist in building a quality-focused culture. With the implementation of the QMS, staff needs to take on additional responsibilities such as the day-to-day consistency checks as part of the data for product quality assurance and control processes.

- **Process approach:** A desired result is achieved more efficiently when activities and related resources are managed as a process. The processes should provide clearly defined accuracy standards and structured formats for all products and services. This enables the efficient management of resources and activities for the delivery of products and services. A QMS can be thought of as a single large process that uses many inputs to generate many outputs. In turn, this large process is made up of many smaller processes.
- **System approach to management:** Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives. These processes should be reviewed and any differences between the ISO requirements and existing processes identified. Quality system procedures should then be developed for these differences and applied so that the processes to achieve the best results can be aligned and integrated.
- **Continual improvement:** this should be an ongoing objective of all organisations that is achieved through the application of all the principles. Specifically, the effectiveness and suitability of the QMS have to be evaluated and areas for improvement identified and rectified. Management reviews have to be conducted regularly using the data collected from the monitoring and measurement process to identify areas for further improvement. Channels may need to be established to allow all staff in the organization to make suggestions on ways to improve the service.
- **Factual approach to decision-making:** organisations perform better when they make informed decisions based on facts. Effective decisions are based on the analysis of data and information.
- **Mutually beneficial supplier relationships:** An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value. Suppliers should be evaluated and selected on the basis of their ability to meet purchase order requirements and on their past performance.

3.7.1 The ISO 9000 family of Standards

“Standards” provide greater structure in the work environment and thereby make life simpler and easier by bringing about advantages such as better quality, more safety and

prompter exchanges. The more widely communicated, accepted and utilized, the better are the standards. ISO has two kinds of quality management standards: requirements and guidelines and together they make up what is known as the ISO 9000 family of standards. There are three standards in the ISO 9000 family of Standards and they represent an international consensus on good quality management practices:

- **ISO 9000:2005 - Quality management systems - fundamentals and vocabulary (ISO 9000):** Describes fundamentals of quality management systems and specifies the terminology for quality management systems.
- **ISO 9001:2008 - Quality management systems - requirements (ISO 9001):** These requirements can be applied to all types of organizations both public and private sector, regardless of size or industry group. It can help both product and service organizations achieve standards of quality that are internationally recognized and respected throughout the world. It is the only standard in the family against which organizations can be certified (or registered) by a third party audit process.
- **ISO 9004:2009 - Managing for the sustained success of an organization - a quality management approach (ISO 9004):** Provides guidance to support the achievement of sustained success in today's complex, demanding, and ever-changing environment. It focuses on achieving sustainable success by meeting the needs and expectations of its customers and other stakeholders. An interesting facet of this standard is that it promotes self-assessment as an important tool that enables ongoing review of the maturity level of the QMS. However, it should be noted that the self-assessment tool is not a substitute for a third party audit process that is applicable to ISO 9001.

3.7.2 ISO 9001 certification and registration

The ISO states that certification process is expected to provide confidence that the organization has a quality management system that conforms to the applicable requirements of ISO 9001. In particular, it is to be expected that the organization:

- has established a quality management system that is suitable for its products and processes, and appropriate for its certification scope;
- analyzes and understands customer needs and expectations, as well as the relevant statutory and regulatory requirements related to its products;
- ensures that product characteristics have been specified in order to meet customer and statutory/regulatory requirements;

- Has determined and is managing the processes needed to achieve the expected outcomes (conforming products and enhanced customer satisfaction);
- has ensured the availability of resources necessary to support the operation and monitoring of these processes;
- Monitors and controls the defined product characteristics;
- Monitoring, measuring and continually improving the effectiveness of its quality management system.

3.7.3 ISO 9000 Critical Success Factors

Many studies have been conducted on the implementation of ISO 9000 in small, medium, and large size companies both in the manufacturing and service sectors (Schiavo, 2000; Saner, 2002). These studies have found that several factors are critical to the successful implementation and maintenance of the QMS, such as the commitment and support from top management, teamwork, and company-wide ISO recognition (Chin et al., 2000; Low and Omar (1997). Other factors of importance reported by the study are the concurrent use of technical and social aspects of QM, and productive relationships. The attitude and behaviour of people working in the organisation are critical to achieving ISO 9000 certification and its maintenance (Wahid and Corner, 2000).

3.7.4 Problems in Maintaining ISO 9000

The literature describes a variety of problems associated with the implementation of ISO 9000. Some of these are mostly due to a lack of top management involvement and understanding of ISO 9000 requirements for the companies' quality systems, the lack of effective internal corrective measures, and not having well-established procedures to maintain their quality systems after ISO 9000 registration (Wahid and Corner, 2009).

Several studies have analysed the management practices associated with ISO 9000. Common themes that have emerged include: management leadership, customer focus development, management of suppliers, employees' relationships, and business processes that are part of ISO 9000 (Singh et al., 2006). Several studies have considered all of these issues together. Specifically, management and leadership have been found to be crucial for the success of any ISO 9000 initiative, and lack of support from senior management in many organisations has seen the implementation and buy-in from employees to be at unacceptably low levels. However, research so far has not clarified whether ISO 9000

assists organisations to develop a greater level of customer focus, or long-term and collaborative relationships with key suppliers. Similarly, it is generally unclear as to how ISO 9000 has impacted on employees in terms of their motivation, attitudes, and relationships with other workers and with the organisation. Finally, it is clear that the standard provides a framework for systematically developing business processes and systems that have clear orientation towards quality assurance and management principles embedded in them (Singh et al., 2006). The literature describes a wide range of problems associated with ISO 9000, which as noted by Lee and Palmer (1999), include its inappropriate use, over-expectations in terms of its value, difficulties in gaining acceptance particularly from internal stakeholders, and problems related to managing the implementation process. Many of these difficulties can be traced back to fundamental weaknesses with the technical and procedural aspects of the standards (Boiral, 2003), as shown in Table 3.5.

Rank	<i>Negative/detrimental outcomes</i>
1	More paperwork
2	More time spent in management
3	Increased bureaucracy
4	Increased staff discontent
5	Higher overall project cost
6	Less flexibility in operation
7	Lower productivity

Table 3.5: Detrimental Outcomes of ISO 9000 (Source: Kumaraswamy and Dissanayaka, 2000)

Santos and Carmen (2002) have also identified some shortcomings of ISO 9000 standards and certification, as follows:

- The ISO 9000 does not guarantee the firm's success. The certification ensures that the product is obtained in a consistent, repeatable manner, but not that it is high quality, or attractive to the consumer. In fact, the ISO 9000 only helps to build a QMS, which is far from providing the opportunity for total quality.
- The ISO 9000 system produces an increase in the firm's paperwork and bureaucracy.
- Some authors claim that the certification can be readily obtained by companies that simply desire to secure the title that comes with it. That is, the market pressures for possessing certification may lead some organisations to a process in which the final objective is obtaining the certification and the resulting image that it lends, rather than one which sincerely aims to develop effective commitment to a quality system.

3.7.5 Benefits of the Implementation of ISO 9000

Many studies, mostly based in the manufacturing sector, have focused on the benefits that organisations derive from ISO 9000. Such benefits are marketing-related, either resulting from mimetic and normative effects, or through becoming early adopters (Singh, et al. 2006). Table 3.6 shows the potential benefits of ISO 9000 certification.

Rank	<i>Positive/beneficial outcomes</i>
1	More systematic record keeping
2	Improved internal communication
3	Better risk management
4	Stronger customer focus
5	Greater client satisfaction
6	Enhanced competitiveness of company
8	Continual improvement of operation
9	Less rework or repair
10	Improved external communication
11	Less problems in defects liability Period
12	Higher efficiency in operation
13	Shorter project completion time

Table 3.6: Benefits of ISO 9000 Certification (Source: Singh et al., 2006).

Several studies have analysed the management practices associated with ISO 9000. Common themes that have been explored are: management leadership (Taylor, 1995a), customer focus development (Terziovski et al., 1995), management of suppliers (Anderson et al., 1999), employees' relationships (Taylor, 1995b), and business processes that are part of ISO 9000 (Douglas et al., 1999). And a number of studies have considered all of these issues together (Terziovski et al., 1997; Lee and Palmer, 1999; Rahman, 2001). The outcome always emphasises the role of management and leadership.

3.7.6 Registration Process

The process involved in implementing the ISO 9000 standard typically involves a four-stage process, as follows:

In the first stage: the organisation conducts a cost-benefit analysis to assess the usefulness of registering to the standard, should the organisation decide to go ahead.

The second stage: involves deciding on the scope of activities that need to be covered.

The third stage: involves producing quality management system, with (or without) the assistance of consultants.

The fourth stage: involves assessors from an accredited registration body examining this documentation and then auditing the system to verify that what is shown in the document is what actually happens in reality. If, in the opinion of the assessors, the documentation properly reflects the processes, which in turn is seen to be compliant with the ISO 9000 standards, registration is granted.

3.8 Similarities and Differences Between QMCs

All of the QM techniques reviewed were originated in developed countries and have different orientations. The similarities, differences, and inter-relationships between them in terms of objectives, concept, methodologies and scope have remained confusing to industry, as each technique has its strengths and weaknesses, and in some cases they overlap. This section highlight the similarities and differences, and the potential of these techniques to improve organisational performance. The overall similarities and differences between the concepts, regarding origin, theory, process view, approach, methodologies, tools and effects, are also presented in Table 3.7.

The selection of an appropriate process improvement methodology depends on the culture of the organisation, and as noted by Nave (2002), the speed at which the methodology will be accepted by the organisation is a function of how closely the QM and the organisational culture fit together (Nave, 2002).

3.8.1 The Origin and Theory

The five principles and the aim of Lean production, like the principles and tools associated with the Six Sigma process are embedded in the principles, concepts, and tools of the holistic management philosophy called TQM (Dahlgard et al. 1998a).

One advantage of Six Sigma compared to the process of implementing the five principles of Lean production is that Six Sigma methodologies offer a specific procedure to follow to secure process improvement in manufacturing, and another specific procedure to adopt outside manufacturing. Especially Motorola's Six Sigma approach for non-manufacturing seems very easy to understand and hence, to apply in the many non-manufacturing processes which are everywhere in any company (manufacturing, service, and public companies).

3.8.2 The Approach

Many organisations have had major problems in implementing some of the tools and techniques involved. TQM emerged from the Japanese experience, and found its way into Western manufacturing organisations, which needed clear direction regarding the change process. This resulted in the development of approaches like Six Sigma, which clarify structural changes. Six Sigma aims at much faster results than TQM. The whole process is hierarchical, top-down financed, and led. TQM aims at widespread involvement and commitment throughout the implementing unit, and include tools and techniques, which can enable any employee at any level to improve his/her daily work on a step-by-step basis. The philosophy aims to use the organisation's own employees and managers and trainers rather than outside consultants. TQM is far less restrictive in its change process than Six Sigma. Lean is a diverse bundle of complementary elements and operating principles. ISO is able to act as a bridging organisation in which a consensus can be reached on solutions that meet both the requirements of business and the broader needs of society, such as the needs of stakeholder groups like consumers and users (Kedar et al., 2008).

TQM is clearly a suitable approach where the quality of the products or services is the major concern. The Six Sigma approach places more stress on the achievement of rapid financial results and involved a much more structured change process. The various approaches are also very different in the way they are practised. For example, ISO formalises a guide to be followed, and incorporates an interdependence between the support tools and the core values of the organisation through the quality criteria. The approaches such as TQM, Lean, and ISO outline a desired end state and demand for self-thinking by the organisation. All the approaches can be useful if handled carefully (Kedar et al., 2008).

Six Sigma could also be described as an improvement programme for reducing variation, through focusing on continuous and breakthrough improvements. The main purpose of reducing variation on a product or a service is to satisfy customers. The goal of Six Sigma is that only 3.4 of a million customers should be unsatisfied (Magnusson et al., 2003), and that this should be achieved through the implementation of a measurement-based strategy that focuses on process and sub-processes improvement through the application of Six Sigma best practice such as DMAIC and DMADV. The former is used to improve existing

processes incrementally, and the latter for developing new processes or products at Six Sigma quality levels.

Lean is a discipline that focuses on process speed and efficiency, or the flow, in order to increase the customer value. While Six Sigma and Lean concentrate on securing improvements mainly through projects, TQM often has a different approach and emphasises the commitment and involvement of all employees.

	TQM	Six Sigma	Lean	ISO
Origin	Japan	Japan, Motorola	Japan, Toyota	Europe
Period	Mid 1980	Mid 1980	1990	1987
Theory	Focus on customers	No Defects	Remove waste	Standard (paper document)
Process View	Improve and uniform processes	Reduce variation and improve process	Improve flow in process	Process system
Approach	Let everybody be committed	Project management	Project management	Project management
Methodology	Plan, DO, Study, Act	Define, Measure, Analyze, Improve, Control	Understand customer value, value stream, analysis, flow, pull, perfection	
Tools	Analytical and statistical tools	Advanced statistical and analytical tools	Analytical tools	Standard tools
Primary effects	Increase customer satisfaction	Save money	Reduce lead time	Create system
Secondary effects	Achieves customer loyalty and improve performance	Achieves business goals and improves financial performance	Reduce inventory, increase productivity and customer satisfaction	Achieves system for process
Risk	Medium	Medium	Medium	Medium
Implementation time	Long term, 5-10 years	Short	Long term, many things are to be learned	Moderate, 3-5 years

Table 3.7: Characteristics of TQM, TPM, Six Sigma, Lean and ISO (Source: Kedar et al., 2008)

3.8.3 Methodology and Tools

Hellsten and Klefsjo (2000) consider methodology as the means by which an organisation achieves its values, and suggest that organisations require tools that are well-defined, concrete, and possibly statistical, since this approach is a support for the analysis of data and to subsequent decision-making.

Tools that are frequently mentioned in the TQM literature include the seven quality control tools and the seven management tools. The improvement cycle is also a common methodology in order to improve the business, according to Evans and Lindsay (1996). The improvement cycle is composed of four stages: plan, do, study, and act (PDSA).

In a Six Sigma programme there are usually many different improvement tools, although Magnusson et al. (2003) document that the Six Sigma toolbox contains: seven design tools, seven statistical tools, seven project tools, seven lean tools, seven customer tools, seven quality control tools, and seven management tools. The tools and techniques used include process maps, quality function deployment, Pareto charts, scatter diagrams, affinity diagrams, brainstorming, the nominal group technique, as well as more substantial quantitative approaches such as correlation analysis, design of experiments, and regression analysis (Pyzdek, 2001). In general, Six Sigma has successfully emphasised the need for a statistical element in QM.

In lean, various tools are available for reducing or eliminating waste, but in comparison with those which characterise Six Sigma and TQM, they are more analytical in nature. However, Lean principles do not always apply when customer demand is unstable and unpredictable. The main elements contributing to the elimination of non-value-added activities are the following: excess processing, delays, transport, inventory, defects and movement. A variety of approaches are available for reducing or eliminating waste. These approaches include value stream analysis, total productive maintenance, Kaizen costing and cost analysis, engineering and change management, and document management. Tools used include Kanban cards for pull through the supply chain and the closely related JIT system for inventory reduction.

It is said that the Six Sigma process and DMAIC is easier to understand, and hence to implement, than the five Lean principles (Roy et al., 2006). Additionally, the Six Sigma methodology offers an organisational structure where certified experts (Master black belts, black belts, and green belts) lead the improvement projects. Six Sigma gives a clear change of structure and is much more orientated towards fast and tangible results in comparison with TQM, and Lean (Kedar et al., 2008). Its main focus lies in the elimination of variation in processes in order to achieve immediate cost savings. Naslund (2008) concludes that Six Sigma is a further development of TQM. He found similarities in the problem-solving process (the Deming wheel, and the DMAIC cycle), the importance of top management commitment, the necessary employee involvement, and in the statistical methods employed.

The following are some of the similarities between the Lean and Six Sigma approaches to process management and improvement:

- Both are process focused or process-centric.
- Both need management support for success, especially in terms of creating the infrastructure and allocation of required budget and time for changing the culture of the business.
- Both can be used in non-manufacturing environments.
- Both are focused on business needs as defined by the customer.
- Both use multi-disciplinary teams to address business problems.
- Both offer complementary tool sets which can be used with other best management practices.

The following are some of the fundamental differences between the Lean and Six Sigma approaches to process management and improvement:

- Application of Six Sigma methodology requires more intense training compared to Lean methodology.
- The implementation of Six Sigma requires more investment as opposed to Lean implementation.
- Lean is fundamentally used to tackle process inefficiency issues whereas Six Sigma is primarily used to tackle process effectiveness issues.

- Six Sigma will eliminate defects in processes, but it will not address the question of how to optimise process flow. In contrast, Lean principles are not very helpful in achieving high capability and high stability processes.

3.8.4 The Effects

There are many different approaches to evaluating the possible benefits of TQM. Historically, one of the most common ways to quantify the benefits of quality has been to estimate the costs of poor quality. In recent years, research has also shown that one of the goals of TQM, customer satisfaction, has a significant positive impact on market value as well as accounting returns.

Much of the increased interest in Six Sigma programmes is due to the positive financial impact which some companies claim these programmes have brought for them.

Indeed, one of the many reasons for introducing Lean techniques in an organisation is the potential for them to contribute substantially to cost-cutting and providing competitive advantages. Other Lean benefits include reduced work-in-process, increased inventory turns, increased capacity, cycle-time reduction, and improved customer satisfaction. According to a recent survey conducted by NIST (2003) of 40 companies that had adopted lean manufacturing, typical improvements are visible in the following three areas:

- Operational improvements (reduction of lead time, increase in productivity, reduction in work-in-process inventory, etc.),
- Administrative improvements (reduction in order processing errors, streamlining of customer service functions so that customers are no longer placed on hold, etc.)
- Strategic improvements (reduced costs, etc.).

3.8.5 Criticism

Nonetheless, despite the known advantages of TQM approaches, there are documented failures, and Harari (1997) states that, after studying all the independent research conducted by consulting firms, the conclusion is that only about one-fifth, or at best one-third, of the TQM programmes in the US and Europe have achieved significant or even tangible improvements in quality, productivity, competitiveness or financial results.

The different opinions concerning what TQM can promote is one important reason for failure as noted by Eskildson (1994), who states that survey results reveal that many organisations do not succeed in their TQM efforts simply because of the vague definition of TQM. Moreover, van der Wiele et al. (2000) discuss whether TQM is a fad, fashion, or fit. A fit of TQM into normal management practice means that the original fad will have affected the usual way of working within the whole organisation and not just a small part, such as would be the case in the adoption of a mere fashion. The fieldwork from van der Wiele et al. (2000) shows that a change to a fit of TQM to other management theories will only occur when there is a strong internal motivation for, and emotional involvement in, the implementation of TQM.

There has not been a great amount of published criticism of Six Sigma, however. Klefsjo et al. (2001) note that Six Sigma has the same common features as TQM, and does not, in principle, contain anything new. In more detail, they state that Six Sigma is a highly disciplined, data-oriented, top-down approach, which typically includes four stages (measure, analyse, improve and control) and the use of statistical decision tools. Despite the several success stories associated with the Lean concept, some shortcomings are identified in the literature as follows:

- The lean organisation may become very susceptible to the impact of changes. The leanness in itself leads to reduced flexibility and less ability to react to new conditions and circumstances (Dove, 1999).
- JIT deliveries cause congestion in the supply chain, leading to delays, pollution, shortage of workers, etc. (Cusumano, 1994).

3.9 The application of QMCs to building maintenance practices.

The concept of TQM embodies the imperative to foster continuous improvement within an organisation. This philosophy underlines the fact that an analytical and consistent approach which involves the entire organisation is implied (Low, 1996), and indeed essential for the proper implementation of TQM. In public sector organisations where the maintenance is government-funded, it is essential to ensure effective implementation, since as noted by Gooijer (2000), the relationship between public organisations and their many and diverse stakeholders is much more complicated than simple transactions between the suppliers and customers involved in the usual private sector dealings. In this

respect, TQM emphasises the need for a good relationship between clients, contractors, suppliers, and customers (Low 1996).

In examining the history of the British building and construction industry, Lin (1990) finds much evidence that exceptional benefits are to be gained by implementing TQM, which are listed as follows:

- It helps to save a great deal of money by reducing the number of errors in work processes, and hence bringing about reductions in wastage and defect liabilities.
- It enables the organisation to achieve greater levels of client satisfaction
- Through the systematic and logical analysis of the different work processes, it helps the organisation to achieve efficiency, improve communications, provide feedback at different levels of the building process, and audit at strategic levels.
- It acts as a psychological tool which motivates employees to correct poor performance and aim for continuous improvement.

In recent years, many empirical and statistical studies have been conducted that have concentrated on generating and testing hypotheses, implementing logical deduction tools, and exploring QM practices in manufacturing firms. The focus on these areas of operation is underpinned by the need to withstand competition. Some of these studies have taken public services as their unit of analysis, but have focused on specific services as provided in hospitals, and education, for example (Ravi and David, 2001), and little research into the use of TQM in public sector construction and BM has been undertaken.

The implementation of Six Sigma follows a strict protocol. First, projects are selected starting with those that are thought to have the highest organisational priority. For many years the process of Six Sigma implementation followed a five-step approach referred to as DMAIC as discussed above. Chowdhury (2001) describes the roles and responsibilities of Six Sigma team members during implementation as including the following:

1. ***Executive leadership.*** This has to be the driving force behind adopting the Six Sigma philosophy and inspiring the organisation from day one.

2. **Executive champion.** The executive champion is appointed by the CEO to oversee and support the entire mission. This sends the signal to everyone that the management of the company is serious about implementing Six Sigma.
3. **Deployment champions.** The deployment champions provide leadership and commitment and work to implement Six Sigma throughout their business and work closely with the project champions. They set and maintain broad goals for projects and ensure that they are aligned with business priorities, negotiate resources for projects and may undertake the administrative and logistical roles in Six Sigma such as preparing and executing training plans (Pande et al., 2000).
4. **Project champions or Team sponsor.** Project champions oversee, support, and fund the Six Sigma projects and the personnel necessary to get the job done. They will typically be the process owners of the projects selected by management.
5. **Master Black Belts.** These are the project managers of the Six Sigma projects and are the people most responsible for fundamental changes in the way the company operates from top to bottom. The role of the Master Black Belts is usually played by outside consultants who act as in-house experts on Six Sigma during the initial stages of implementation. These consultants serve as coaches and mentors and will help the champions to select good projects and the people to run them at the top end. They will also teach the core points of Six Sigma to Black Belt candidates throughout the company at the lower end. When the people they have trained are ready, they will take over the job of Master Black Belts from the consultants.
6. **Black Belts.** The Black Belts are the people who really work. They are the ones, apart from the Master Black Belts, who work full-time on the job (Hoerl, 1998). They are the key to the whole project, the true leaders of Six Sigma.
7. **Green Belts.** They provide the Black Belts with the support they need to get the projects done. Their job scope is identical to that of the Black Belts except that they maintain a 'real' job in the organisation and work part-time on Six Sigma projects.

Because Six Sigma is a relatively new concept for many organisations, relevant training is essential for those involved. This typically lasts for four weeks and may spread over a few months. After each week of training, the Black Belts go back to the workplace and put into practice what they have just learned. The purpose is to allow trainees to practise what they have learned so that the learning curve is better consolidated. There are four core phases of training to match the four main points of the Six Sigma strategy: How to measure, analyse,

improve, and control the processes that produce increased customer satisfaction, company savings, and a healthier bottom line. These four phases of training include statistics, quantitative benchmarking, and design of experiments (Pheng and Hui, 2004).

While Six Sigma has been adopted by many organisations around the world, the main areas where it has seen the most work are banking and financial services, healthcare, construction, supply chain management, accounting, customer relations, public utilities, material procurement, education, libraries, order processing, the airline industry, safety and even the government and non-for-profit organisations. Edgeman et al. (2005) describe how the US government is using Six Sigma to increase the quality of service it provides in this time of uncertainty. And Reece (2006) describes how Six Sigma is aiding the US Department of Defense in managing budgetary constraints. Matchette (2006) on the other hand, describes the various other ways that the US Department of Defense benefits from Six Sigma (Nakhai and Neves, 2009).

It is only in recent years that Six Sigma has been utilised by some of the major players in the construction sector (Stewart and Spencer, 2006). In 2002, the Bechtel Corporation, one of the world's largest construction and project management companies, reported savings of \$200 million after an investment of \$30 million in its Six Sigma programme (Kwak and Anbari, 2006). Six Sigma has also been implemented on the St Pancras Station (London) project as part of the extension of the Channel Tunnel Rail Link. Specifically, it was initiated to improve the construction of raised platform beams with the explicit aim of identifying particular activities that were causing defects and delays (Stewart and Spencer, 2006).

In addition, The Housing and Development Board (HDB) under the Ministry of National Development in Singapore applied Six Sigma approaches to improve the quality of internal finishes for public housing projects. In this case improvement measures taken by a contractor helped to raise the sigma level from 2.66σ (77.39%) to 3.95σ (99%) (Pheng and Hui, 2004). However, as most of the Six Sigma initiatives are in the manufacturing, health care, and service industries, there were problems for the Master Black Belts themselves to find suitable information and case studies on how Six Sigma can be applied in the building industry. To resolve this problem, the HDB requested the Master Black Belts to include

examples of how the various tools could be used in environments that are similar to the building industry (Pheng and Hui, 2004).

The lean application in construction, as suggested by Koskela (1992), brought to light the following **11 principles** which must be implemented in order to design, control, and improve the construction projects. The first four principles, as they relate to construction, are:

- **Principle 1:** map the value stream, which identifies the value added, non-value added, and wasteful activities,
- **Principle 2:** consider the customer's requirements,
- **Principle 3:** identify the root cause of variability and eliminate it,
- **Principle 4:** perform actions which contribute to cycle time reduction. Examples of cycle time reduction include addressing waste in production due to inventory, work-in-progress, large batch sizes, layout to minimise transportation or introducing parallel activities, etc.

Principles 5, 6 and 7 provide guidance on actual processing practices, on site improvements and controls that aid the employees as much as they assist in increasing productivity. The transparency principle suggests the use of means and methods that allow a production system to communicate with those who are part of it through employing indicators and the display of information throughout production areas.

- **Principle 5:** Modularisation and standardisation are strategies that, in addition to increasing process transparency through the use of standards, would result in productivity improvements and serve as a basis for increasing flexibility (e.g., different combinations of modules would allow products with different configurations without compromising productivity and ultimately the time and cost to provide a product).
- **Principle 6:** Flexibility depends on small batch sizes to allow for quick response to change, providing product customisation late in the process, and forming a multi-skilled workforce.
- **Principle 7:** transparency introduces visual controls to promote communication at all levels, enhances work areas via layout and signage, enforces benefits of diffusion of

information, standards, and organisation, orderliness, cleanliness, personal cleanliness and discipline (last five also known as housekeeping —5SII) (Koskela, 1992).

- **Principle 8:** the focus is shifted to a global and inclusion aspect. The entire project is viewed as a whole. For example, focusing on the complete process can highlight how the entire project benefits from external players like suppliers. Supplier inclusion can benefit the complete process by ensuring the in-time delivery of the required amount of correct materials to the work site, promoting the continuous flow of work and avoiding a delay in the start of work.
- **Principle 9:** poses the need for continuity, referring back kaizen, i.e., small incremental changes, by setting attainable targets that can be measured and monitored, delegating responsibility for improvement to all employees, rewarding improvement, and advocating a challenge for better solutions.
- **Principle 10:** is a reminder of thorough process flow (flow activities) improvement, before introducing a new technology which is the most costly solution to any problem.
- **Principle 11:** introduces the concept of benchmarking which encourages research and adaptation of best practices from leaders in other industries to the construction industry (Koskela, 1992).

The building industry has a large number of specialised areas and disciplines, many based on cyclic processes. Proponents of lean construction argue that it is possible to identify the wasteful activities in the processes and to make concessions for them. This leads to a better understanding of such processes and an improvement in the overall performance (Dunlop and Smith, 2004). The basic improvement rationale is to compress the cycle time by eliminating non-value adding time (Koskela, 1999). Cycle time includes process time, inspection time, wait time and, according to Koskela (1992) and Thomas et al. (2002), lean construction includes: the practice of just-in-time (JIT), use of pull-driven scheduling, reduction of variability in labour productivity, improvement of flow reliability, elimination of waste, simplification of the operation, and implementation of benchmarking.

The majority of the applications of Lean Six Sigma reported in the literature have been in the private sector, mostly in the manufacturing industry, and typically in larger companies. However, many experts in Lean and Six Sigma suggest that the tools can be used in non-manufacturing settings including: software development, service industries

such as customer service call centres, education, in administrative functions such as accounting and order processing, material procurement, and new product development (Bossert and Grayson, 2002). In a review of the literature, no evidence was found, however, of local governmental entities using a combined approach of Lean Enterprise and Six Sigma.

That said, the City of Kingsport Tennessee received a Good Works Initiative grant from the American Society for Quality (ASQ) to reduce costs and improve the service reliability of trash collection (American Society for Quality, 2002). The goal of the Good Works Initiative is to transfer Quality knowledge to not-for-profit, community-based organisations. Although the literature does not provide cases where Lean Six Sigma has been implemented in local governments, there is evidence in the literature of the application of quality principles and tools in the public sector.

The implementation of ISO 9000, had contributed to some improvement for firms by increasing their management efficiencies and overall image of the company but also brought with them increased bureaucracy, paperwork cost and time consumption. Many other similar surveys (Jones et al., 1997; Tang and Kam, 1998; Leung et al., 1999) have also been conducted. O'Brien (1996) had mentioned that it is very difficult for organizations which do not measure quality costs to appreciate fully the costs and benefits associated with operating an ISO 9000 QMS. To determine if ISO 9000 is effective in improving the quality of construction works the beneficial way, there is a need to test it via a quality costs quantifying exercise (Low and Yeo, 1998). Davis et al. (1989) and Abdul-Rahman (1995) had previously investigated the cost of quality in construction. However, their objectives were to show the importance of and the applicability of quality costing per se and not draw its relationship to ISO 9000.

3.10 Summary

This chapter has considered several aspects of Quality Management Concepts, and describe similarities and differences between TQM, Six Sigma, Lean, Lean Six Sigma, and ISO Quality Management. It has been shown that these different concepts do in fact have many similarities, especially concerning their origin, methodologies, tools, and effects. However, the concepts also differ slightly in some areas, particularly concerning

the main theory, approach, and the main criticisms made of them. What has been revealed is that the concepts are complementary.

This chapter has examined the five QMCs in order to select one of these concepts for this study. These perspectives will be explored to the research inquiry into the current QMC employed by public BM departments in Saudi Arabia.

Quality Management Concepts are likely to remain as a key initiative in any effort to improve the management process, wherein the primary focus should be on improving overall management performance. The main advantage is that it uses the people within the organisation to reach a practical solution to quality issues. The large number of studies that have addressed the concept of quality in construction industry, there is limited research into the use of these QMCs as a strategy for process improvement in BM industry specifically. The standardisation of practice is the starting point, and any lack of internal motivation can prevent this from happening. Moreover, it is seen that it is not actually possible to improve quality in all respects simply by standardising practice. The next chapter will look into research design and methodology.

Chapter 4: Research Design and Methodology

4.1 Introduction

This chapter provides details of the research design employed to achieve the aim and objectives of the study stated in Chapter One. In total it considers research philosophy, and epistemological and ontological approaches, before discussing the types of data that can be gathered. The tools used in the study are detailed and the actual processes undertaken are described, again in detail, all with justifications for the actions followed. All of this contributes towards the research design.

Research design is usually considered after identifying the research objectives and before starting to collect data. Saunders et al. (2009) state that a research design must clearly describe the general plan of how the research objectives will be answered, and provide a justification of the methods selected and employed for a particular study. Yin (2003:160) defined research design as *“a logical plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answer)”*. According to Leedy and Ormrod (2001, 121) research design is *“the procedural framework within which the research is conducted”*.

Given the main aim of this study is to investigate the quality management system required to improve Saudi public BM practices through the implementation of the most suitable and effective QMCs. It is important to study the reality of BM practice and identify the current perception and implementation of QMCs in Saudi BM. This chapter provides a rationale for the epistemological stance adopted in studying that reality, and describes and justifies the methodology employed to investigate BM and QMCs in Saudi Arabia. This involves not only detailing how the data was collected, but also the techniques of analysis used to interpret that data.

4.2 Research Philosophy

The built environment in general, and the construction industry in particular, rely for their functioning on inputs from the areas of natural science, social science, engineering, and management. Hence, construction management research generally follows the approach adopted in the social sciences since people as well as organisations are involved.

Specifically, construction management researchers choose methodologies that reflect both scientific and humanities approaches (Carter and Fortune, 2004).

However, irrespective of the particular methodologies chosen, in all research, it is necessary to appreciate the fundamental ontological and epistemological stance adopted by the researcher. That is to say, the researcher's view of reality, and the view of how knowledge is generated (Thomas, 2004). As further clarification of these two stances, Trigg (2001) notes that ontology is "*the theory of what there is*", whilst Tuffin (2005) observes that epistemology seeks to answer questions about "*how we may come to know*". Burrell and Morgan (1979), in focusing on sociological paradigms, identified the two ontological assumptions of realism and nominalism, and the two epistemological assumptions of positivism (objectivism) and anti-positivism (subjectivism). Their assumptions reveal that in realism, ontological reality exists independently of human consciousness and cognition, whereas in nominalism reality is simply a product of individuals' minds, a projection of their consciousness and cognition, with no independent status. The epistemological view of positivism (objectivism) suggests that it is possible to observe the empirical world in a natural manner through the accumulation of objective sense data, while the anti-positivist (subjectivism) perspective holds that there is no natural foundation for knowledge, since all observation is value.

In construction management research, it is possible to observe three methodological paradigms that are appropriate, these being the positivist, interpretivist, and combined or pragmatic approach (Falqi, 2011). The positivist paradigm is based on realist ontology and objectivist epistemology, and usually takes the form of deductive research and makes use of quantitative techniques. On the other hand, the interpretivist method is founded on nominalist ontology and subjectivist epistemology, and typically takes the form of inductive research and makes use of qualitative techniques.

In addition, the selection of specific methodological strategies within a piece of research aligns with whatever paradigm a researcher would position his/her research in. Guba and Lincoln (1994) suggested that when researchers assume certain research paradigms, they provide answers to the following issues:

a) The ontological issue which is associated with the form and nature of reality,

- b) The epistemological issue which is related to the researcher's perception about knowledge, and
- c) The methodological issue which is relevant to how a researcher figures out what can be known.

Table 4.1 provides clarification of the characteristics of the two research paradigms.

Variable	Research Paradigms (1)	Research Paradigms (2)
Ontology	Realist	Nominalist
Epistemology	Objectivist	Subjectivist
Methodology	Positivist	Interpretivist
Technique	Quantitative	Qualitative

Table 4.1: The Characteristics of the Two Research Paradigms (Falqi, 2011)

With respect to the current study, since one of the objectives of this study is to discover the current BM processes in organisations and to find explanations for their use, it can be understood that it is both exploratory and explanatory. However, exploration and explanation cannot be achieved without observing the processes under investigation, and seeking people's opinions. Consequently, the study is located in the interpretivist paradigm, and is nominalist and subjectivist in its approach. Thus, ontologically, the study is nominalist, and epistemologically, it is subjectivist. Clearly, the positivist approach may also play an important role in as much as it is important to know facts and figures, such as how regularly BM processes are conducted, and which people are involved. But such an approach is merely complementary, and can never produce the understanding that is possible by use of the interpretivist philosophy.

Interpretivism is one of four major research paradigms that can be identified within the entire body of qualitative research, as noted by Klenke (2008), who highlights these approaches as being constructivism, interpretivism, symbolic interactionism, and pragmatism. In all of these approaches, the researcher tries to penetrate the reality of his/her subject matter, using observation, case studies, interviews, and ethnomethodology (Grint, 2005; Selsky and Smith, 1994; Maitlis and Lawrence, 2007; Ligon et al., 2008).

This particular study is conducted via semi-structured interviews and focus groups, a strategy that allows for the interpretation of information relating to the BM process which

is obtained by questioning senior personnel who are engaged in the reality of that process. The semi-structured interviews are designed to secure information which will enable the first and second objectives of the study to be achieved. Specifically, these relate to the need to build a picture of the current BM process and the common problems associated with it, and to the need to explore how QMCs are perceived and implemented in public BM. The focus groups are designed to secure information which will enable the third objective of the study to be achieved. Specifically, this relates to what QMCs can be effective in the BM industry in the public sector.

This research is exploratory; it has been involved in the processes of identifying a real problem. The aim of the research is to investigate and develop the Quality Management System (QMS) required to improve Saudi public Building Maintenance (BM) practices through the implementation of the most suitable and effective Quality Management Concepts (QMCs). The final outcomes of the research (the developed QMS based on ISO 9001 standard) cannot be tested in practice in the short term, as the tangible results require the application of the system at least on several projects, and that could take months. However, the QMS is assessed by a number of experts, and this could be considered practical research. To reach to the research aim, this study must provide a structured method of determining the level of power and interest for public clients that will allow them to manage building maintenance job orders effectively. The developed quality management system will determines the level of the stakeholder communication and responsibilities to manage building maintenance activities that exists as a phenomenon outside the people who might use it, the researcher figure out this methodology should adopt an objectivist position and positivist characteristic of the research as evidenced in the nature of the research outcomes

Clearly the methods used to obtain data are important elements of any research study, and are related to the type of research. The next section considers research types in more detail.

4.3 Research Types

Tan (2004) classified research types in several ways, drawing distinctions between pure and applied; exploratory, descriptive, interpretive and causal; and qualitative or quantitative. Phillips and Pugh (2000, 64) defined research as “*finding out something you*

do not know” and classified it into three basic types: exploratory, testing-out, and problem solving, which applies to both qualitative and quantitative research.

Often researchers use exploratory approaches for an inadequately defined problem area. Indeed, the ambiguity of a problem seems to be the driving force being the adoption of an exploratory perspective. This particular strategy is employed in this study because it enables the collection of information that will establish the precise activities within the BM process, the problems involved, and whether QMCs are used, and to what effect.

4.4 Research Methods

According to Silverman, (2004, p 306), a research method is *“the choices the researcher makes about cases to study and methods to be used for data collection and data analysis planning as well as carrying out the research study”*. Thorpe and Lowe (2002) provide a similar definition, mentioning that research methods are about organising research activity, including the collection of data, in ways that are most likely to achieve the research aims.

In respect of qualitative and quantitative approaches, Frankel and Devers (2000) identified three central differences. The first relates to the inductive nature of qualitative research and the deductive nature of quantitative research; the second relates to the greater degree of flexibility inherent in qualitative inquiries; and the third concerns the fact that quantitative designs are linear. Becker (1996, 66) believes that qualitative scholars *“focus on the question to be answered rather than on procedures to be followed”*. According to Creswell (2007, 15): *“qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore social human problems. The researcher builds a complex, holistic picture, analyses words, reports detailed views of informants and conducts the study in a natural setting”*. And According to Denzin (1994, 16) *“Qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means qualitative researchers study things in their natural settings, attempting to make sense of, or interpret these things in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials - case study, personal experience, introspection, life story, interview, observational, historical, interactional, and visual texts that describe routine and problematic moments and meanings in individual's lives”*.

Bogdan and Bilken (1998) highlighted five characteristics of qualitative research, indicating that it is naturalistic, collects descriptive data, has a concern with process, is inductive in approach, and searches for meaning. Rallis and Rossman (2011), on the other hand, identified eight features, these being: it is naturalistic, it takes into account the humanity of the respondents, it is dynamic, interpretative, and illustrates social context and reality, it encourages researchers' insightfulness, it offers a precise/authentic reflection of participants' lives, and it relies on a sophisticated rationale.

Despite these genuine advantages of qualitative research, it does nonetheless, suffer from certain shortcomings as follows: (1) the data can be biased and consequently, the researcher must pay attention to controlling for this (Antonakis et al., 2004); (2) the data is subjective (Bryman and Bell, 2003); (3) small samples are usually used, and these may not always be representative of larger populations (Lamnek, 1995); (4) there is an absence of statistical analysis (Lamnek, 1995). These criticisms of qualitative inquiry often encourage researchers to adopt quantitative approaches.

The quantitative research method was originally developed in the natural sciences to study natural phenomena (Myers and Avison, 2002). It is generally associated with deductive research, which is a top-down approach in which a hypothesis is constructed, and theory, would be examined by data. In this approach, researchers principally adopt a positivist perspective in respect of knowledge development (Creswell, 2003). According to Fellows et al. (2003), quantitative research relies primarily on the collection of numerical data to study correlations between facts and the theories and findings of previous research. It is suitable for collecting factual evidence concerning an issue and testing a particular theory or hypothesis using that evidence (Naoum, 1998). Typically, the data are numeric (Blaxter et al., 2010), are collected from large samples of individuals (Creswell, 2011a), and are mostly analysed using statistical techniques (Lancaster, 2005).

Like qualitative research, quantitative research also has its weaknesses, and a major criticism of quantitative approaches is that they cannot provide a complete picture of a phenomenon. Al-Yami (2008) confirms this problem, noting that many researchers recognise the difficulties of using quantitative approaches to investigate management practice, and opt for a qualitative strategy. Indeed, Olscheske (1999) makes the point that for research that focuses on process, understandings, and interpretation rather than on

deductive and experimental approaches, qualitative methods are necessary, since they can offer deep understanding and provide significant data interpretation. The appropriate research strategy to this study is the inductive one since it is precisely such a deep understanding of BM phenomena that is sought. Specifically, there are other reasons why the inductive strategy is used, these being: (1) pragmatic findings can emerge from inductive research (Halinen, 1997); (2) it is possible to generate theory (as desired for the BM process) (Bryman and Bell, 2003); (4) a deep appreciation of the BM industry can be obtained (Conger, 1998).

The justification for using qualitative methodology in this research relates to the benefits it can bring as follows: (1) it provides ‘words’ rather than ‘numbers’ (McLeod, 2003; Antonakis et al., 2004), and is thus of great value in trying to acquire a deep understanding of BM phenomena; (2) it allows for a better appreciation of complex phenomena (Stogdill, 1974; Bass, 1981; Day, 2000; Conger, 2004), and the construction industry is a complex one; (3) it is more appropriate than a quantitative approach when the researcher wishes to explore reality (Conger, 1988), and it is an exploration of the BM process as currently enacted which is required in the study; (4) it uses methods that add substantial explanation (Geertz, 1973), and can therefore provide superior analysis of the BM industry; (5) it offers an “*understanding and exploration of human’s social lives*” Ohman (2005, 274; Ospina, 2004); and (6) its methods aim to achieve ‘depth’ rather than ‘breadth’ by focusing more on exploring in much detail, a smaller number of instances or examples which are perceived as being interesting and enlightening (Blaxter *et al.*, 2010).

4.5 Research Ethical Considerations

Kvale (1996) clarifies the core ethical matters in which researcher ought to consider when conducting qualitative interviews; (1) informed consent which refers to summarily explaining the whole picture of the study to the interviewees, introducing the study’s objectives and rationales; (2) confidentiality raises the privacy of information gained from the interviewees, also complying with any issues regarding confidentiality and signing consent forms to conduct the interview; and (3) consequences states the significance of telling the interviewees what consequences can be expected. Christians (2000) highlighted four key ethics; informed consent, deception, privacy and confidentiality, and accuracy. The following table (4.2) illustrates the ethical issues

Stages of an interview investigation	Ethical issues
Thematising	The interviews' aims ought to further more academic purposes
Designing	Informing the interviewees about the study, and confidentiality
Interviewing	Being cautious of any sort of pressure on the interviewees
Transcription	Being accurate in scripting the subjects' speeches
Analysis	Analysing the interviews genuinely
Verification	Considering the verification through writing up the data

Table 4.2: The Ethical Issues (Kvale, 1996)

Heriot-Watt University has established the University Ethics Committee to guide schools, monitor procedures and ensure appropriate ethical issues are being considered. The committee has asked schools to submit ethical approval procedures relevant to their research activities (HWU, 2010). Therefore, the researcher was asked by the School of the Built Environment to submit the protocol for the ethics approval form before conducting each type of fieldwork.

The researcher was fully aware of the school procedures and assured all participants in each survey that *“this study has been reviewed and received ethics clearances through the office of research ethics at Heriot-Watt University”*. Although no consent forms were required for the surveys, the participants were informed that *“the data collected will be kept confidential and no firm, organisation or individual will be identified in the thesis or in any report or publication based on this research”*.

4.6 Research Methodology

In the light of what has been said thus far, the study chooses to employ an interpretivist methodology using qualitative techniques of data collection and analysis to achieve the research aim and objectives presented in Chapter One. This approach was chosen after properly establishing the gap in the published research, which became apparent having conducted the literature reviews in the areas of Building Maintenance and Quality Concepts (Chapters Two and Three respectively). Table 4.3 illustrates the overall methodological approach adopted for the study.

Ontology	Epistemology				Research Objectives
		Approach	Methods	Data Collection techniques	
Subjectivist	Interpretivist	Inductive	Qualitative	Interviews	1 and 2
Subjectivist	Interpretivist	Inductive	Qualitative	Focus group	3
Subjectivist	Interpretivist	Inductive	Qualitative	Focus group	4

Table 4.3: Methodological Approach

As indicated in Table 4.2, the first qualitative exercise relates to an interview process conducted with individual BM practitioners as a means of collecting information regarding the first and second research objectives. This was followed by a second qualitative technique - the use of focus group discussion, intended to achieve the third research objective, and to finalise and validate the outcomes from the first objective. The data gathered via these procedures was then analysed in order to establish the generic BM processes and determine a suitable QMC for the BM industry in the Saudi public sector. After the development of the quality management system the focus group method was used a second time as a means of validating the advice to be provided to BM practitioners (as explained later in the chapter).

The qualitative processes undertaken are considered to be the most appropriate to achieve the research objectives, which are repeated in Table 4.4 for ease of understanding.

Research Objectives	Research methodology	Research Method	Expected Outcomes
To design and examine the current business processes in the BM department, with a view to ascertaining underlying problems and potential areas for improvement.	Qualitative	Interviews	BM process BM common problems
To evaluate and explore QMCs with a view to understanding their awareness and applicability to public building maintenance departments.	Qualitative	Interviews	QMCs awareness and barriers for implementation

To explore and assess the most suitable and effective QMCs to be implemented in building maintenance departments.	Qualitative	Focus Group	Selected the effective QMC
To develop and validate an appropriate quality management system for building maintenance in order to improve the business processes.	Qualitative	Focus Group	quality management system for BM & Refinement of the quality management system BM industry

Table 4.4: Integration of Research Methods and Objectives with Expected Outcomes

4.7 Research Analysis Method

Clearly, the use of interviews and focus groups implies the collection of a large amount of data in the form of words, and in respect of analysis, this can be both time-consuming and problematic. In most cases, it is usual for such data to be analysed thematically, but this must be performed in a systematic way that results in credible answers to the research objectives embedded within a study.

Bernard and Ryan (1998) provided a useful typology for understanding the range of qualitative data as shown in Figure 4.1. At the first branch of the tree, data are divided into three basic types: text, images, and sound. This study focuses exclusively on text, which is by far the most common form of qualitative data analysed in the social sciences.

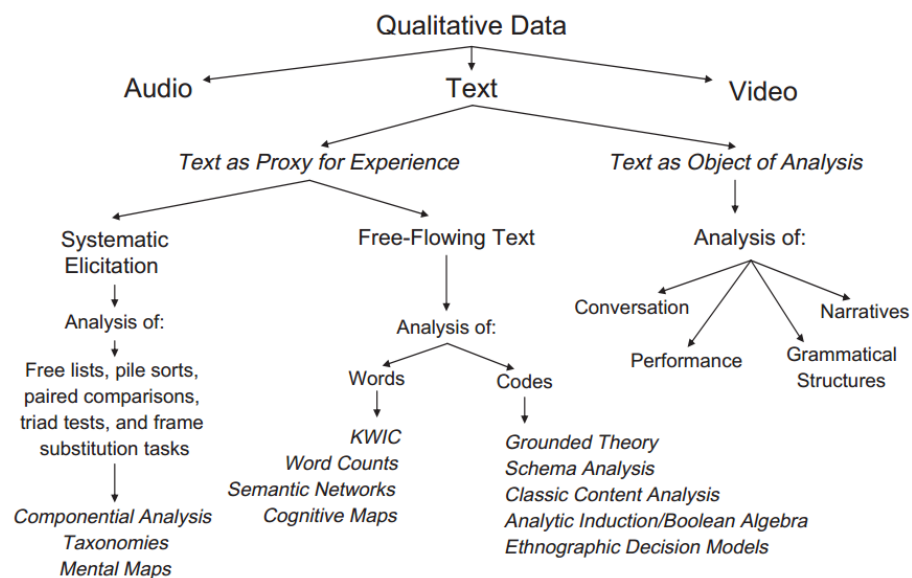


Figure 4.1: The Range of Data Generated in Qualitative Research (Source: Bernard and Ryan, 1998)

At the second level in the tree, text can be viewed either as a proxy for experience or the object of analysis. In this study it is analysed as a proxy for experience as the researcher is interested in participants' perceptions, feelings, knowledge, and behaviour as represented in the text. This type of text analysis, known as the sociological tradition (Tesch, 1990), is the method most often employed in the social sciences when interpreting qualitative data (Bernard, 2010).

When considering text as a proxy for experience, there is substantial breadth in the ways data can be collected and analysed. However, because the qualitative data collected in this study are in the form of free-flowing text (i.e., focus groups and in-depth interviews), the focus is on the 'free-flowing text' branch of the tree, which subsequently divides to consider on the one hand, words, and on the other, themes and codes (Bernard, 2010). In the vast majority of cases, the analysis of codes (thematic analysis) is employed in this study rather than word-based analysis because that is more suitable for a quantitative approach.

Thematic analysis should be seen as a foundational method for qualitative analysis. It is the first qualitative method of analysis that researchers should learn, as it provides core skills that will be useful for conducting many other forms of qualitative analysis (Bernard, 2000). Indeed, Corbin and Strauss (2008) argue that the most useful approach for capturing the complexities of meaning within a textual data set. It is also the most commonly used method of analysis in qualitative research.

One of the benefits of thematic analysis is its flexibility, since it allows a researcher to identify, analyse, and report patterns (themes) within data. Codes are then typically developed to represent the identified themes and applied or linked to raw data as summary markers for later analysis. However, there is no one ideal theoretical framework that can be used when conducting qualitative research, or indeed one ideal method. What is important is that the theoretical framework and methods match what the researcher wants to know, and that they acknowledge these decisions, and recognise them as decisions. Thematic analysis can be an essentialist or realist method, which reports experiences, meanings, and the reality of participants, or it can be a constructionist method, which

examines the ways in which events, realities, meanings, experiences, and so on, result from a range of discourses operating within society (Braun and Clarke, 2006).

Braun and Clarke (2008) provided an outline to guide researchers through the six phases of analysis, as summarised in Table 4.5. In this respect, it is important to recognise that qualitative analysis guidelines are not rules, and that these need to be applied with flexibility in order to fit the research objectives and data (Patton, 1990).

Phase	Description of the Process
1. Familiarising yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic ‘map’ of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Table 4.5: Phases of Thematic Analysis (Source: Braun and Clarke, 2008)

However, despite the variation according to the questions and data, Morgan (1995) observes that most qualitative researchers work with transcribed data generated from in-depth interviews and focus groups that are typically 1 to 2 hours in length. Transcripts for these data collection activities may range from 10 to 40 pages per individual or group, with focus groups leaning toward the longer end of the range.

In this study, thematic analysis is used for the data obtained from the interviews and focus group discussions. Each area of the interview and focus group discussions is analysed, participants’ answers are allocated to particular themes, and examples are presented to indicate the generality of responses to the questions. It is assumed by the researcher that this procedure will result in the presentation of a logical and coherent picture of the issue under investigation.

4.8 Research Design

In designing the entire research plan, it is essential to include all the stages of a study that are required to accomplish the research aim and objectives. The design for this study encompasses six phases, each of which is followed by an appropriate level of analysis to confirm and explore the main findings thus far. Figure 4.2 illustrates the design.

4.8.1 Stage 1: Literature Reviews

By conducting a literature review, a researcher demonstrates that s/he has acquired a professional command of the background theory (Phillips and Pugh, 2000). It is necessary to do this in order to develop a comprehensive grasp of existing knowledge and thus be able to make an original contribution to knowledge rather than repeating what has already been discovered (Naoum, 2006). Consequently, in this thesis, reviews of the literature form two important chapters that provide the theoretical background, and indeed a justification, for the research undertaken (Bruce, 1994).

The initial stage of this research involves collecting secondary data through reviewing published works concerning the nature of the BM industry, and this involves studying previous research efforts that have considered the BM process in all its facets. This review is presented in Chapter Two, which also explores the situation of the BM sector in Saudi Arabia and its value to the nation. Additionally, it studies BM as it occurs within organisations, and hence, the processes entailed.

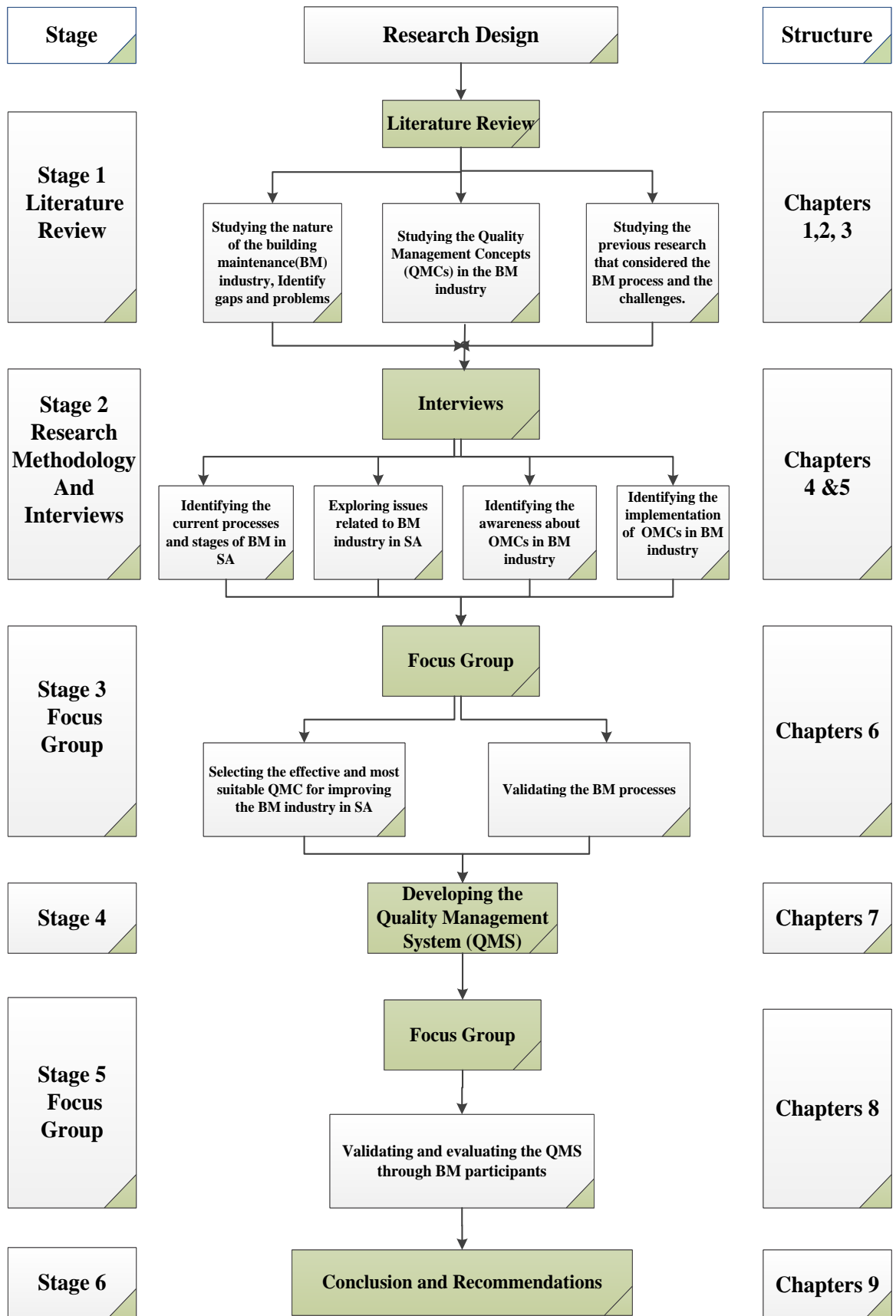


Figure 4.2: Overall Research Design

The next stage of the study involves collecting secondary data concerned five Quality Management Concepts (QMCs), and this is presented in Chapter Three. The concepts considered are Total Quality Management, Six Sigma, Lean Management, Lean Six Sigma, and ISO 9001, and in each case the principles, methodologies, benefits of introduction, and difficulties of implementation are discussed, all with a view to their use in the construction industry

These two literatures review produce the outcome that the background to BM and QMCs is firmly established, thereby allowing for the appropriate design of the empirical fieldwork.

4.8.2 Stage 2: Qualitative Interviews

Qualitative semi-structured interviews are chosen as the method by which to identify the current practice of BM processes in SA (first objective), establish the awareness of QMCs within the BM industry, and identifying any levels of implementation of these in that context (second objective). Corti and Thompson (2004) note that the collection of qualitative data is typically done to ensure that the lived experiences of people can be captured as also can the meanings which people give to those experiences from their own perspectives. Interviewing is one way of collecting such data.

Berg (2001) describes the interview as a conversation held for the purpose of gathering information, and Schostak (2006) points out that through an interview one can extract insights into the experiences, beliefs, values, knowledge, interests, concerns of another individual, whilst simultaneously being able to understand the reasoning and actions of that person. There are three main types of interview, referred to as structured, semi-structured, and unstructured (Kumar, 2005). The structured interview does not allow for in-depth probing of any issue, and as noted by Bryman and Bell (2003), it prevents the researcher from exploring how things are done in practice. Essentially, it is not a useful method in exploratory research and in cases where the intention is to develop concepts. The unstructured interview, at the other end of the range, is more appropriate for investigating and understanding a general area (Saunders et al., 2009) as this does allow for in-depth questioning and discussion. However, in between these two extremes of approach, the semi-structured format of interviews is more manageable, questions can be changed or added depending on the interview situation, in-depth discussion can take place, but the researcher is able to exercise more control. Hence, the advantages of this approach are that data are somewhat more systematic than in the informal

conversational interview, and more general than in the structured interview. In order to address the first two research objectives, it was decided that interviewing was the most appropriate method to use for data collection, and that of the types available, the semi-structured interview was the most suitable in its ability to offer the degree of flexibility required by the researcher.

- ***The Philosophy Behind the Sample***

The scope of the research is confined to BM departments in public organisations in Saudi Arabia, and to one type of participant – public sector clients, which include ministries and governmental institutions. The majority of the targeted departments are located in Riyadh City. In fact, 23 public organisations have their own Building Operation and Maintenance Departments, but only 12 of these agreed to participate in the study.

In order to conduct the structured interviews, it was first necessary to establish the sample of interviewees, and the number of organisations from which they were to be selected. The selection criterion was the level of seniority, as individuals in senior positions are likely to possess a larger amount of information related to the research objectives (BM processes and QMC awareness and implementation).

The number of interviews to be conducted was then considered. Twelve interviews from twelve different public organization was believed to be sufficient. The interviews should be undertaken using a semi-structured format, held face-to-face with professionals currently working in the public sector, and that the interviews would be recorded. It was decided to secure a snowball and purposive sample.

Table 4.6 presents the details of the 12 interviewees from different public organisations, each with an average of 15 years' experience. Interviews lasted between 30 minutes and two hours, participants were recruited from two levels (middle-management and top management), and had worked specifically in the maintenance management area for a number of years. As a result, they all had wide experience and held high positions in the BM sector. Consequently they were invited to return later in the study to participate in the focus group sessions as it was considered that they would provide valuable feedback regarding the general maintenance process diagram and the selection of an effective QMC. In total, eight managers, and four assistant managers comprised the interviewees, and their average experience was 15 years.

All participants were given a letter of introduction, a business trip letter, and an interview permission letter from the researcher's University, prior to commencement of the interviews (Appendix A). In addition, they were given a list of the intended interview questions to familiarise them with the subject and context of the interviews, and to allow them adequate time to consider their responses and to prepare any useful material they might want to bring with them. Prior to the interviews, the researcher requested permission to record each conversation on an audio recorder, and agreed to guarantee that all information provided would be for academic use only, and would remain completely confidential. This permission was given by all interviewees.

The use of recorder is helpful both in the analysis of the interview data, but also as a means of releasing the interviewer from the responsibility of making notes and enabling him/her to full participate by being able to follow up on interesting points. As noted by Bryman and Bell (2003), the tasks required of the interviewer (such as keeping to time schedules, questioning where necessary, and drawing attention to any inconsistencies in the interviewee's answers) should not be compromised by the distraction of documenting the interview. The total time recorded for all the interviews was 769.88min (i.e. 12 hours and 38 minutes in total).

All interviews were conducted in the Arabic language, this being the first language of all participants and the interviewer. This gave every opportunity for interviewees to express themselves clearly. Immediately after the interviews, the researcher began the process of transcribing the proceedings, which as noted by Bryman and Bell (2003) is a time-consuming process, taking professional transcribers between five to six hours to transcribe one hour of speech. In this study, it took approximately ten hours of transcription for each hour of speech, as this involved transcribing into a text document, and then translation from Arabic to English by a professional translator. This translation was then compared by the researcher with the original Arabic transcripts to ensure there were no distortions of the data.

Interview No#	Position title of the Interviewee	Organisation Name	Quality Knowledge	Industry	Experiences	Interview duration
Int. 1	G.M. Assistant of Maintenance Dept.	Ministry of Health	---	Public sector	15 years	66.31 min
Int. 2	Administration Services Manager	Public Pension Agency	ISO 9001	Public sector	14 years	52.44 min
Int. 3	G.M. Assistant of Maintenance Dept.	General Directorate of Border Guard	---	Public sector	14 years	123.38 min
Int. 4	Operation & Maintenance Dept. Manager	Ministry of Transport	Six Segma	Public sector	10 years	55.35 min
Int. 5	Head of Facilities Maintenance	Ministry of Defence and Aviation	TQM & ISO	Public sector	26 years	58.04 min
Int. 6	Operation and Maintenance Director	Saline Water Conversion Corporation	ISO 9001	Public sector	25 years	38.01min
Int. 7	Head of Engineering Department	Medical Services for Armed Forces	TQM	Public sector	10 years	54.17 min
Int. 8	Maintenance Manager Assistance	King Saud University	----	Public sector	18 years	82.57 min
Int. 9	G.M. of Directorate of Building Information	Ministry of Municipal and Rural Affairs	----	Public sector	30 years	71.05 min
Int. 10	Maintenance Manager Assistance	General Organisation for Social Insurance	----	Public sector	8 years	30.27 min
Int. 11	Maintenance Manager Assistance	Ministry of Municipal and Rural Affairs	----	Public sector	14 years	68.44 min
Int. 12	Maintenance Engineer	Ministry of Transport	----	Public sector	10 years	30.27 min
				Total		769.88 min

Table 4.6: Profile of Interviewees

Once the data was ready, the researcher began to read them line by line, writing the primary codes, and preparing to use Nvivo. The Nvivo is computer software uses for analysing qualitative data, Nvivo refers to: “*In vivo is Latin for “within the living” and refers to experimenting using a whole live system*” (Chipounov, Kuznetsov, et al. 2011, 1). Nvivo used widely in analysing qualitative research (Bazeley, 2013; Richards, 2002). It is believed that the Nvivo software cannot be the generator of analysis, as: “*analysing qualitative data: more than ‘Identifying Themes’*” (Bazeley, 2013, 6). Nevertheless, it was helpful in terms of organising the data, and in point of fact, it is a genuine archive for your data; as it is easy to deal with data via using Nvivo. The Nvivo helps in coding data and then thematising them into core categories. This software will be used in focus group data as well.

- ***Format of the interviews***

The main questions in the semi-structured interview (see Appendix B), which in some cases were supplemented by supportive sub-questions that served to further explore the specific issues included in the main questions. As indicated, the interviews were recorded, transcribed into a text document, and then translated. Prior to conducting the individual interviews, informal contact was made with the participants, and they were sent an official request letter from the university and details of the interview questions.

The duration of each interview varied, the shortest being 30 minutes, and the longest two hours. In every interview, the researcher spent the first five minutes explaining the background to the study (research topic, research gap and support, research aim and objectives). The interviewee was then asked to express his opinion on the BM process and the quality of work produced. Interviewees were encouraged to comment on the research objectives in the context of their experience in their current departments, and were given opportunities to discuss additional issues associated with quality in BM which they felt were important.

The outcomes of the interviews were a full picture of the generic process for public BM, the identification of existing deficiencies in the BM process within the public sector, an understanding of the current levels of awareness and appreciation of the QMCs, and the levels of effective implementation of QMCs. These outcomes are reported in detail in Chapter Five.

4.8.3 Stage 3: Qualitative Focus Group

The second qualitative strategy, the focus group method, was used to collect data to allow the achievement of the third research objective, associated with establishing the most suitable and effective QMCs in the public BM sector, and to validate the proposed model of BM.

The focus group discussion method is a valuable approach in qualitative enquiry as it provides an environment for a homogeneous group of professionals and experts to interact and freely exchange ideas and opinions, and at the end of the discussion, to establish a consensus view on a particular topic (Morgan, 1997; Rea and Parker, 2005). The technique is one of the best-known for interviewing and generating qualitative data (Fellows and Lui, 2008; Phillips and Stawarski, 2008). When compared with other qualitative strategies, the focus group discussion has the strength that the data is gathered in a socially-oriented atmosphere which is more relaxed than in a one-to-one interview (Marshall and Rossman, 2011).

Gibbs (1997, 74) describes focus group research as involving “*organized discussion with a selected group of individuals to gain information about their views and experiences of a topic*”. Similarly, Greenbaum (2000) characterised the focus group as a qualitative technique employed to elicit data through a group of people drawn together in one location to tackle some questions that are of great concern to the researcher. One aim of focus groups is to encourage interaction between participants on a series of topics. These groups bring the most benefit when they are used to generate ideas and stimulate discussion about a given concept, and they can be successfully applied in exploratory investigations. When the goal is increased understanding, problem-identification, and improvement in implementation, focus groups may, in fact, be the optimal choice for eliciting information. Consequently, this method was considered the most suitable to enable the achievement of the third research objective, and four focus group sessions with representatives from the Saudi BM industry were held to confirm the most suitable and effective QMCs for implementation in their context.

- ***Number in the groups and participants***

The most common rule of thumb when conducting focus groups is to anticipate the need for between four to six groups to be assured that the topic has been thoroughly exhausted but not saturated. Zeller (1993b) makes the point that after the first few

groups, it becomes possible to predict what participants in subsequent groups will say, and at this point the data becomes 'saturated' and surplus to requirements. Morgan (1996) has suggested that diversity in either the participants or the range of topics to be covered will increase the number of groups necessary to achieve saturation.

Clearly, the desirable number of focus group sessions depends upon the nature and complexity of the subject under investigation and the use for which the data generated by the focus group are to be employed. Powell and Single (1996) observe that anything from one to 10 sessions are generally suitable for most studies, since at some juncture the group's discussion will simply replicate existing data, making further sessions unnecessary.

What is important for all groups, however, is that the participants have enough time for in-depth discussions, and hence, as noted by Morgan (1996) the number of items for discussion should not exceed six or seven. Furthermore, the composition of the group should be homogeneous, with members sharing similar background and experience. Seating arrangements should facilitate maximum interaction among participants, and the best arrangement is for participants to sit around a table facing each other.

In terms of the ideal number of participants for a focus group session, Krueger and Casey (2000) suggest between six and eight participants as the ideal. Harvey-Jones (1988) refers to effective group sizes as being between six and eight, and notes that using smaller groups shows greater potential. A group should be large enough to ensure representation of different viewpoints, but small enough to provide an opportunity for each participant to exchange comments freely (ibid 2008). Morgan (1996) reviewed the issue of group size, concluding that smaller groups are more appropriate for emotionally-charged topics that are likely to generate high levels of participant involvement, while larger groups work better with more neutral topics that encourage lower levels of involvement. In a smaller group, each participant has more time to discuss his/her views and experiences of the topic, whereas a larger group contains a wider range of potential responses but more limited opportunity for these to be aired. From the moderation viewpoint, the discussion has to be managed and the moderator needs to ensure that all participants have the chance to contribute.

- ***Advantages and Limitations of Focus Group Sessions (FGD)***

As a mode of data collection, FGS have several advantages. First, they enable the researcher to gather information rapidly. A FGS with 6 to 10 people can be conducted within an hour or two, which is much less time than it would take to interview all the members individually; and while the group meeting may not provide the same depth of information that might be gained in individual interviews, a skilled interviewer can still obtain considerable information and understanding from group interviews. Secondly, when impending deadlines impose severe time constraints, group interviews may be the only viable alternatives.

A third advantage is that group participation can sometimes reduce individual inhibitions, thereby providing information that might not be otherwise shared. In some cases, people in groups are willing to share feelings, emotions, and concerns that they would be reluctant to express in more private settings.

Fourthly, members of focus groups are able to raise issues and concerns that the researcher might not have considered. Group members generate new ideas and approaches because they stimulate each other, and a group dynamic emerges that encourages the participants to respond to each other's ideas and comments, thereby opening up fresh lines of inquiry. Another major advantage of FGS is that they permit direct interaction between participants and the researcher, thereby providing him/her with a broad view of the situation, as it is possible also both to listen to respondents and watch their expressions, and those of other members.

A further advantage of using focus groups for this type of evaluation is that individuals are generally interested and pleased to provide their opinions.

- ***Format of the Focus Group Method***

Each participant was invited by telephone to attend the focus group session two weeks before the session was due to take place, and were subsequently sent an email with an official letter, the focus group protocol, and the map of the generic BM process (See appendix D). During the week before the FGS was conducted, all participants were contacted to confirm their intention to attend to the discussion. In the focus group sessions, each participant was introduced to the main aim of the session.

Four separate focus group sessions were held in Riyadh, Saudi Arabia's capital city each group was comprised of different participants. Seven participants attended the first focus group session, eight attended the second, five attended the third, and six attended the fourth (see Table 4.7). It is good practice not to allow focus group sessions to extend beyond two hours since boredom can arise among members, and this advice was followed in the study. The researcher assumed the role of moderator for all four sessions, and began each one by introducing himself, explaining the aim of the session, addressing confidentiality concerns, and outlining the overall process. All focus group sessions were recorded.

The sessions took place in a fully integrated meeting room at the five star Alanoud Hotel in the evening. Resources present included: notebooks and pencils, a flip chart, a focus group script, list of participants, markers, name tags, meeting agenda, and a clock (Figure 4.3). Refreshments and snacks were served during the meeting. After the meeting all the participants were invited to an open buffet dinner. The reason for holding the events in a hotel was to encourage and motivate participants to attend; the setting was intended to be comfortable and respectful of people in high positions with considerable experience.



Figure 4.3: Fully-integrated meeting room

A few weeks before the start of the group sessions, the statement of intent, identification of the participants, the meeting agenda, and the participants' information were sent to all participants for each session. Each session was scheduled to last approximately two

hours. Since focus groups usually last one to two hours, it was important to ensure proper timekeeping and that the upper limit was not extended.

Details of the participants' work experience, role, and level in their organisation are presented in Table 4.7. The table provides an excellent indication that the feedback and comments collected in the focus group sessions represent a valuable insight into views held across the BM industry, since the participants are shown to possess distinctive operational and maintenance experience, and to have professional and expert backgrounds relating to the industry. Representatives of BM and consultants, many of whom had participated in the interview stage of the research, were invited to be members of the sessions. In this respect, the researcher explained their role as experts within the sessions. Some individuals who had participated in the interviews, recommended others who had not been involved in the research thus far, to be invited. Consequently, the actual membership was gained through a snowballing technique. In total, 26 people participated in the focus group sessions, each of whom came from a BM department and was happy to be involved in validating the data collected at the interview stage.

The researcher acted as a moderator and facilitator, an essential role in focus group discussions to ensure the efficiency and effectiveness of the process. Specifically, this involved managing the more outspoken group members, keeping the discussion of each topic on track, acting as a timekeeper, and making sure that all focus group participants had the opportunity to provide input if they so wished.

		Position and title of the Participants	Organisation names	Experience	Meeting
Group 1	1.1	Maintenance Director	Public Pensions Agency	30 years	112 Minutes
	1.2	G.M. of Directorate of Building Information	Ministry of Municipal & Rural Affairs	30 years	
	1.3	Operations & Maintenance Dept. Manager	Ministry of Transport	10 years	
	1.4	Master Black Belt	Consultant	24 yeas	
	1.5	Quality Development Manager	Saudi Standards, Metrology and quality organisation	32 years	
	1.6	Head of Engineering Dept.	Medical Services for Armed Forces	10 years	
	1.7	Maintenance Manager	Saline Water Conversion Corporation	25 years	
Group 2	2.1	G.M. Assistant of Maintenance Dept.	Ministry of Health	15 years	120 Minutes
	2.2	Head of Facilities Maintenance	Ministry of Defence and Aviation	26 years	
	2.3	Building Maintenance Engineer	Ministry of education	8 years	
	3.4	Maintenance Manager	King Saud University	8 years	
	2.5	Administration Services Manager	Public Pension Agency	14 years	
	2.6	Master Black Belt	Consultant	24 years	
	2.7	Quality Development Manager	Saudi Standards, Metrology and quality organisation	32 years	
	2.8	Maintenance Manager Assistance	Ministry of Municipal & Rural Affairs	14 years	
Group 3	3.1	Maintenance Manager Assistance	Ministry of Municipal & Rural Affairs	15 years	79 Minutes
	3.2	Maintenance coordinator	Saudi Industrial Development fund	16 years	
	3.3	Master Black Belt	Consultant	24 years	
	3.4	Quality Development Manager	Saudi Standards, Metrology and quality organisation	32 years	
	3.5	Maintenance Engineer	National Gas and Industrial company	6 years	
Group 4	4.1	Head of operation and maintenance section	Ministry of Defence and Aviation	15 years	94 Minutes
	4.2	Services and Facilities Manager	Ministry of Trade	17 years	
	4.3	Projects Manager	Ministry of Transport	10 years	
	4.4	Mechanical Engineer	Ministry of Health	10 years	
	4.5	Projects General Manager	Ministry of Transport	20 years	
	4.6	Quality Development Manager	Saudi Standards, Metrology and quality organisation	32 years	

Table 4.7: FGD Participants

Two consultants were invited by the researcher to participate in all focus group sessions, with the purpose of encouraging the proposed members to attend. The researcher's aim was to ensure that all sessions had adequate numbers of participants, and that all of them would be motivated to contribute. The first consultant was a Master Black Belt Six Sigma with 24 years' experience of working in the private sector, and an excellent grasp of QMCs through his background in this respect. The second consultant was ISO certified, with 32 years of experience applying the principle of ISO in both the public and private sector. Both consultants were able to provide the participants with information about each QMC from a practical perspective, in contrast with the researcher's largely academic and theoretical presentation. The ultimate aim was to configure the groups with individuals capable of providing the highest quality discussion regarding the topic being researched. In the main, the consultants were silent, recording their impressions of the meeting, and only assisting where required in the discussion phase. It was important to minimise any bias which their presence may have introduced and therefore they were asked to avoid any attempt to influence the participants' views in relation to QMCs.

The researcher's presentation during the focus group sessions was designed to brief participants on the nature of the topics that would be explored to meet the objectives of the current research phase. This identified the need to gather data describing participants' views of the five QMCs, and the subsequent intention to analyse that data in order to determine those QMCs that were most likely to be successfully implemented in the BM environment. Thereafter, the members were encouraged to introduce themselves to the group.

All the focus group discussions were tape recorded, and immediately after each session, the proceedings were transcribed verbatim from the recording. The notes made by the participants during the session were also collected and analysed. Once the data was ready, the researcher began to read them line by line, writing the primary codes, and preparing to use Nvivo. Subsequently, the researcher sent an acknowledgment email to the participants that included a summary of the session, a scanned copy of all the participants' business cards, and photographs that were taken during the meeting and the following dinner.

- ***Procedure within the Focus Group Sessions***

The process of validating the generic BM within the focus group sessions, and selecting the most suitable, and likely effective QMCs for the BM industry, is illustrated in Figure 4.4. In step 1, the participants were asked to introduce themselves and their jobs or responsibilities. The researcher then made a presentation on the QMCs (TQM, ISO 9001, Lean, Six Sigma, and Lean Six Sigma), explaining each one separately, and then encouraged the participants to interact and discuss the questions.

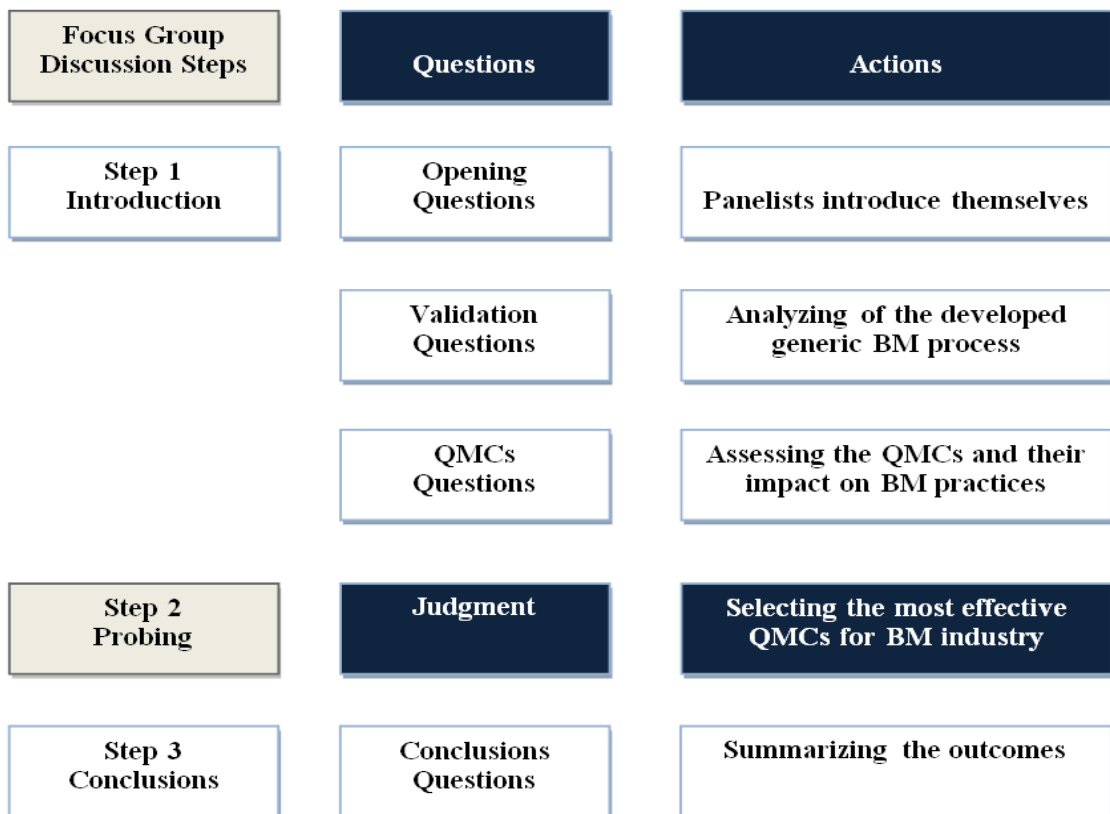


Figure 4.4: The Focus Group Discussion Steps

In step 2, two key questions were put to the participants. The first question asked for their overall opinions regarding the arrangement and structure of the generic BM process, whilst the second sought opinions on which QMCs were believed to be suitable for implementation in the BM sector. During the discussion on each question, the participants interacted with each other, listened to all viewpoints and fully debated the topic. The moderator then expressed and summarised the key points.

In Step 3, the researcher briefly summarised the main points of the discussion. The participants were also asked if they wished to add any comments to the summary. At the end of the focus group sessions, the researcher gave a closing statement summarising the results of the discussion, and thanking the participants for their valuable time and input. The outcomes of the focus group sessions are discussed in detail in Chapter Six.

4.8.4 Stage 4: Developing the quality management system for BM

The implementation of an effective Quality Management System (QMS) offers a clearly structured, systematic approach to improving the customer experience (Hoyle, 2001), so helping to meet BM department's aims and objectives and successfully implement management for the delivery of its services.

The aim of having a quality management system is to create a framework of reference points that ensures that each process within an organization is performed using the same information, methods, skills, and controls and applied in a consistent way (Dale et al. 2007; Hallström, 2000). A quality system should assist in defining requirements, communicating policies and procedures, supervising the work performed and improve overall teamwork (Dale et al., 2007). It is important that documents are established that describes the quality management system and the activities through which quality is created, assured and continuously improved (Dale et al., 2007). The fundamental documents behind quality management systems are: (1) quality manual describing the quality policies and quality objectives in line with company policies and objectives; (2) a procedures manual describing the functions of the system and outlines the structure, responsibilities and practices for each department or business unit; and (3) other documents containing work instructions, specifications, and methods of how to perform work activities (Dale et al., 2007).

BM department will benefit from establishing an effective quality management system (QMS). A QMS can be defined as: “*A set of co-ordinated activities to direct and control an organisation in order to continually improve the effectiveness and efficiency of its performance*” (Hooper, 2002). These activities interact and are affected by being in the system. The main thrust of a QMS is in defining the processes, which will result in the improvement of quality services, rather than in detecting defective services after they have been performed (Wilson, 2002). Lam, Low and Teng (1994, 15), in the context of

construction, define 'quality system' as "*the organisational structure, responsibilities, procedures, processes and resources for implementing quality management*". Successful implementation of a QMS, requires effective planning, operation and review, as well as continuous improvement of the system at all levels of an organisation. Effectiveness has been defined by the British Standards Institute (BSI) (2009) as the extent to which planned activities are realised and planned results are achieved. The term 'effectiveness' is particularly pertinent to quality management system implementation, as organisations that adopt a QMS must meet their specified quality requirements and prescribed quality objectives without any shortfalls, in order to be seen have successfully implemented their QMS. The context of an effective QMS implementation is to ensure that work is performed according to specification, throughout the construction and servicing, and also ensure that customers are satisfied with the resulting products and services (Beaumont 2006).

The quality management system can be seen as a complex system consisting of all the parts and components of an organisation dealing with the quality of processes. A QMS can be defined as the managing structure, responsibilities, procedures, processes, and management resources to implement the principles and action lines needed to achieve the quality objectives of an organisation (Hooper, 2002). A good QMS does not in itself make an organisation more profitable, efficient or customer focussed, but it will give to an organisation the ability to do anything better. Thorpe and Sumner (2004) have proposed a several indirect benefits of a QMS to identify, which give opportunities to:

- Review business goals, and assess how well the organisation is meeting those goals;
 - Identify processes that are unnecessary or inefficient, and then remove or improve them;
 - Review the organisational structure, clarifying managerial responsibilities;
 - Improve internal communication, and business and process interfaces;
 - Improve staff morale by identifying the importance of their output to the business, and by involving them in the review and improvement of their work.
-
- A fully documented QMS will ensure that two important requirements are met:
 - The customers' requirements – confidence in the ability of the organisation to deliver the desired service consistently meeting their needs and expectations.

- The organisation's requirements – both internally and externally, and at an optimum cost with efficient use of the available resources – materials, human, technology and information (ibid 2011).

These guideline concepts should be able to assist BM departments in the establishment and implementation of their QMS. For the purposes of the current study, the researcher has chosen to use the term 'QMS', bearing in mind the definition given above. This is accepted as the description for work undertaken by the researcher since the intention is to devise an organised procedure for the effective management of BM in Saudi Arabia. Indeed, a major objective (as stated in Section 1.3) is to develop a QMS to help improving BM process in SA. The advantage of developing such a QMS is that it would allow for the resolution of various BM problems (Naveh and Marcus, 2005; Peyrat, (2001)). In an attempt to employ quality as a key component of the success of construction businesses today, many researchers state that it requires a well-implemented QMS in order to ensure the effectiveness of the QMS (Ahmed et al. 2005; Cachadinha 2009; Farooqui and Ahmed 2009; Shibani, Soetanto and Ganjian 2010).

In fact, it is essential to specify the BM industry when developing such a customised QMS, yet to the best of the researcher's knowledge, no previous study has established a QMS to link QMC to the BM industry.

• **Need for a QMS**

Based on the findings revealed from the previous stages of this research, it was noted that there is a clear absence of implementation of QMC in the BM industry. This was not an unexpected finding; indeed this knowledge and understanding formed the rationale for the study, but it is worth pointing out that the researcher's own observations were confirmed in the interview sessions and in the focus groups. Consequently, this research makes an attempt to fill this gap in BM industry research by developing the quality management system for the Saudi public BM industry began after identifying the most suitable and effective QMC from the four focus group sessions. This development of QMS in the BM industry would lead to better management of BM process and improve the workflow of the BM management process.

The implementation process of a quality management system is a process for improving quality (Dale et al., 2007). In order for quality to be improved in an organization, certain changes need to be done. There are several methods and tools that can guide an organization towards improved quality, but since no organization looks the same or has the same point of departure when implementing a QMS, the process of implementation needs to be adjusted to better fit the specific organization and context. Each organization is unique in, for example the business culture, the structure, goals and objectives, the hierarchy etc., which means that there is no universal method for quality improvement. Therefore quality management systems suggest frameworks for improving quality, not strict implementation guides that should be followed explicitly (BS EN ISO 9001:2000).

- **QMS Development**

In this research, the methods applied to develop a QMS to better manage BM management process is based on the data will be explored in focus group sessions to select the most suitable and effective QMC. A representative sample of public clients was adopted to ensure the QMC would be applicable to them in the BM stages. The development of the QMC went through two stages which were (a) develop an initial QMS based on the most effective QMC in BM industry in SA, and (b) validate the QMS design by experts in Saudi BM industry.

4.8.5 Stage 5: Validity and Credibility in Research

Oberkampff and Trucano (2008) define validation as “*a process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model*”. Validation refers to the process of determining the degree of system/framework accuracy to practicality in implementation (Thacker, et al., 2004). In addition, the validation approach needs to investigate if the model/framework behaves as the real world under the same conditions (Miser, 1993 and Pidd, 2009). Therefore, the acceptance of the experts is considered as a key factor for the success of the system or framework and its validity when applied in public construction projects (Pidd, 2009). However, the design of focus group session and the characteristics of the invited participants to the judgements session are vital factors that can help in achieving effective and realistic framework assessment (Pidd, 2009).

The validation stage of the scientific method could be described as determining if the aim of the research has been achieved (Bock, 2001). In this research, the developed QMS was validated through a focus group workshop, and therefore, the validation approach was performed through seeking public clients. Miser (1993) and Pidd (2009) argue that useful and realistic views of validation affirm the potential utilisation of models as the means of validation, which entails some researchers considering validation with regard to the practicality of use of the framework. In this respect, the technique of the validation workshop and the selection of contributors involved in making judgments and feedback play an essential task in obtaining utilitarian and pragmatic views.

- ***Validity Assessment***

Building a system for better quality management based on limited views of participants from the previous stages of the study does not necessarily mean this system can be applicable and effective to all public sectors. Schwab (1999) asserts that researchers are always interested in generalizing the findings beyond the investigated cases. The motivation for carrying out a focus group session to validate the developed QMS is that experts involved in a mature practice may have insights that would not otherwise be available to the researcher. Thus, it is the quality of the insight that is imperative, rather than the number of participants who share it (Wainwright, 1997).

Whilst research studies that investigate a small number of cases may achieve good validity by providing a deep understanding of the practice. Schwab (1999) affirms that there is no systematic or verifiable method to perform external validation based on a single investigation of a research relationship. However, the ultimate approach to assess the validity of the developed QMS would be to examine such principles in reality; but within research practice this is hardly possible (Pyett, 2003).

Testing the developed QMS by the application method, it could take long time before a fair judgment of the QMS's validity could be achieved. In fact, in this research this was considered difficult to obtain. However, several other techniques were available to maximize the validity of the QMS in this research as follows:

- Selecting experts in the field for the exploratory the feedback in the focus group session.
- Seeking assessments of the effectiveness, clarity and applicability of the QMS in the building maintenance industry by experts from public sectors.

- ***Reflexivity in Research***

Reflexivity is a tool whereby we can include our “selves” at any stage, making transparent the values and beliefs we hold that almost certainly influence the research process and its outcomes. Reflexive research encourages us to display in our writing/conversations the interactions between ourselves and our participants from our first point of contact until we end those relationships, so that our work can be understood, not only in terms of what we have discovered, but how we have discovered it. For myself and other like-minded individuals, these are ethical, moral, and methodological issues (Frank, 1995; Josselson, 1996; McLeod, 2001).

Reflexivity in qualitative research is usually perceived as a way of ensuring rigor (Finlay, 1998; Koch & Harrington, 1998; Rice & Ezzy, 1999). Reflexivity involves critical reflection of how the researcher constructs knowledge from the research process—what sorts of factors influence the researcher’s construction of knowledge and how these influences are revealed in the planning, conduct, and writing up of the research. A reflexive researcher is one who is aware of all these potential influences and is able to step back and take a critical look at his or her own role in the research process. The goal of being reflexive in this sense has to do with improving the quality and validity of the research and recognizing the limitations of the knowledge that is produced, thus leading to more rigorous research. It does not have an overtly ethical purpose or underpinning.

- ***QMS Validation: Aims and Objectives***

The main aim of the validation was to test the QMS’s effectiveness, clarity and applicability to ensure that the developed QMS would add value to the Saudi public building maintenance industry. To accomplish this aim, the following specific objectives were proposed as follows:

- To identify expert participants’ perception towards validity of proposed QMS in terms of its practicality, clarity and applicability.

- To discuss and validate what success and barriers the experts think it would have.
- To Confirm the BM stages in the proposed QMS.

- ***Validation Technique***

The focus group approach has been recommended for validating the QMS because it allows participants to express independent opinions and allows the sharing of experiences, and it provides suitable atmosphere for fruitful discussion rather than individual interview (Ritchie & Lewis, 2003) (as discussed in section 4.7.3). This session was comprising of eight managerial staff of eight organisations as shown above in table (4.8), some of whom had participated in the interview phase. Due to the constraints relating to the time required to assemble multiple groups, one focus group can be regarded as acceptable, as long as the data is properly interpreted. In addition, the composition and the characteristics of the participants, as well as the dynamic of their discussion, ensure that the content of the discussion is appropriately focused when dealing with the limitations of using just one focus group.

	Position and title of the Participants	Organisation names	Experience
1	General Manager	Alekhtiar Consultation Engineering	30 years
2	Projects Manager	Saudi Oger LTD	30 years
3	Consultant	The Specialist Group	10 years
4	Executive VP for Projects	Tatweer Building Company	24 yeas
5	President	OMAIN TIC	32 years
6	Maintenance Director	SASO	10 years
7	Facility Director	Al Raeda Company	25 years
8	Program Manager	MOE	18 years

Table 4.8: FGD Validation Participants

The focus group session was conducted during the *International Operation and Maintenance Conference in the Arab Countries* that was held in Dubai 2014. Thereafter, the results were analysed qualitatively and the validity of the quality management system established. Further details are provided in Chapter Eight.

- ***Procedure within the Focus Group Sessions***

The process of validating the developed QMS within the focus group session is illustrated in Figure 4.5. The validation session consisted of three steps as described below:

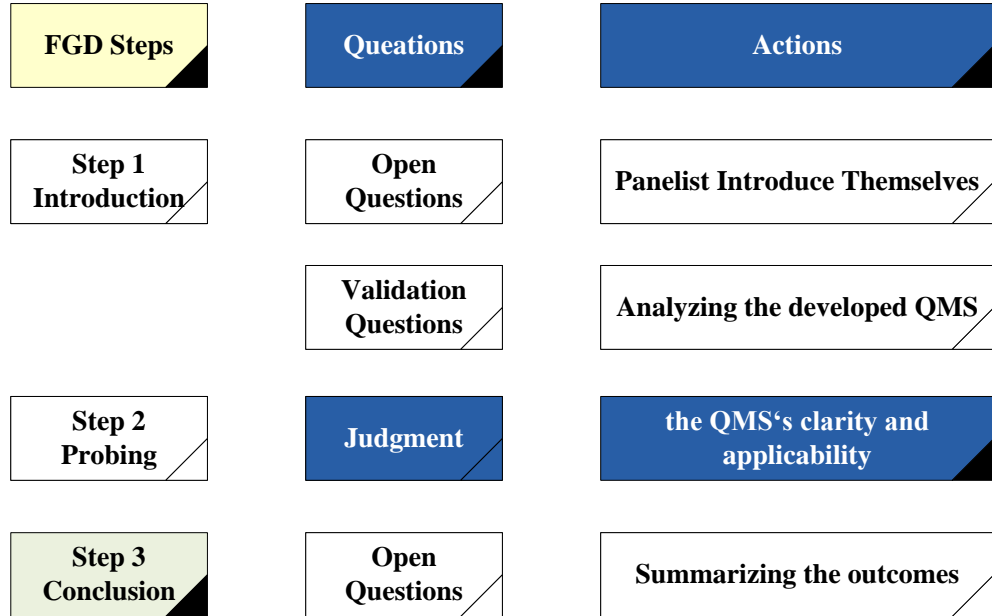


Figure 4.5: The Focus Group Discussion Steps

In step 1, the participants were asked to introduce themselves and their jobs or responsibilities. The researcher then made a presentation on the developed QMS explaining the QMS's clarity and applicability to ensure that the developed QMS would add value to the Saudi public building maintenance industry, and then encouraged the participants to interact and discuss the questions.

In step 2, a presentation was provided to clarify and explain the developed QMS, its levels and clause, which was to seek their cooperation by expressing their perception about the QMS's applicability in building maintenance projects. Two questions were put to the participants. The first question dealt with overall opinions of the clarity of QMC's arrangement and structure. The second question related to the applicability of QMS in BM departments. The presentation included the background of the research, the aims and objectives of the research, research methodology, data collection and findings and the process applied to develop the QMS.

The researcher explained why the research intends to manage BM process by engaging the selected QMC and how this would influence the proposed QMS to better manage BM process. The researcher also explained implementation of the QMS clauses during the BM process. Additionally, the potential successes and barriers to the QMS application were discussed with the participants and the solutions to overcome them. Then, open discussion led to acquisition of useful feedback and good judgment from the participants.

The focus group session focused on validating one key issue for the developed QMS: the applicability of QMS scope to be practices or not in Saudi public building maintenance projects and the implementation of QMS. All of these criteria (Themes) aim to confirm the QMS applicability.

In Step 3, the researcher briefly summarised the main points of the discussion. The participants were also asked if they wished to add any comments to the summary. At the end of the focus group sessions, the researcher gave a closing statement summarising the results of the discussion, and thanking the participants for their valuable time and input. The outcomes of the focus group sessions are discussed in detail in Chapter eight.

4.8.6 Stage 6: Conclusion and Recommendations

This stage involves drawing conclusions based on the research results and framing recommendations for future development. Additionally, the limitations of the study are identified at this point.

4.9 Summary

This chapter has discussed the methodology adopted for the study, providing a full justification for all the choices made in this respect, relating both to the collection of data, and its subsequent analysis. It is shown that pragmatism is used as the underlying philosophy. The techniques of interview and focus group discussion have been presented and the precise ways in which the interview exercise, and the round of focus groups was conducted have been highlighted to indicate the rigour with which these empirical exercises were undertaken. A clear presentation has also been made of the methods of analysis.

Within the chapter, the research design has been clearly demonstrated, and the linkages between each of the six stages and the research aim, objectives, and questions are made

clear. Stage one, embracing the two literature reviews were seen to gather background knowledge from which to identify the direction of the study and the appropriate research approach. Stage Two, consisting of the qualitative interviews produced opinions on the two issues under investigation (the existing BM process, and knowledge and understanding of QMCs). Stage Three, comprising the focus group sessions pursued these issues in more depth, and facilitated the selection of the most suitable and effective QMC for BM. Stage Four developed the quality management system, and Stage Five validated this through the final focus group discussion. Lastly, Stage Six in which conclusions and recommendations will be drawn. The following two chapters discuss the results obtained from the interviews (Chapter Five) and the focus group sessions (Chapter Six).

Chapter 5: Interviews - Results and Analysis

5.1 Introduction

This chapter presents the findings from the interviews conducted with professionals from BM departments in public sector organisations in Saudi Arabia. It examines in detail, the findings from the twelve individual semi-structured interviews were conducted as discussed in Chapter Four. The chapter starts by illustrating details of the interview outlines. Thereafter, the method of interview analysis (thematic analysis) is illustrated (in Section 4.6). The common problems found to exist in the current BM process are then discussed. This discussion is followed by an assessment of the current QM practices in BM departments. Finally, the barriers to the implementation of QMCs are highlighted.

5.2 Interview Themes

Themes and emerging concepts during the process of analysis the data were carefully listed and noted. A point worth noting is that the interview guide provided wide range of themes based on the interview questions and objectives to support the building maintenance practice in the Saudi public industry.

The interview was comprised of four main themes (See Figure 5.1). The first **theme** aimed to collect information concerning the current processes and stages in BM practice in Saudi Arabia. Based on literature, the researcher outlined a draft of the BM process which he presented in each interview (See below Figure 5.3).

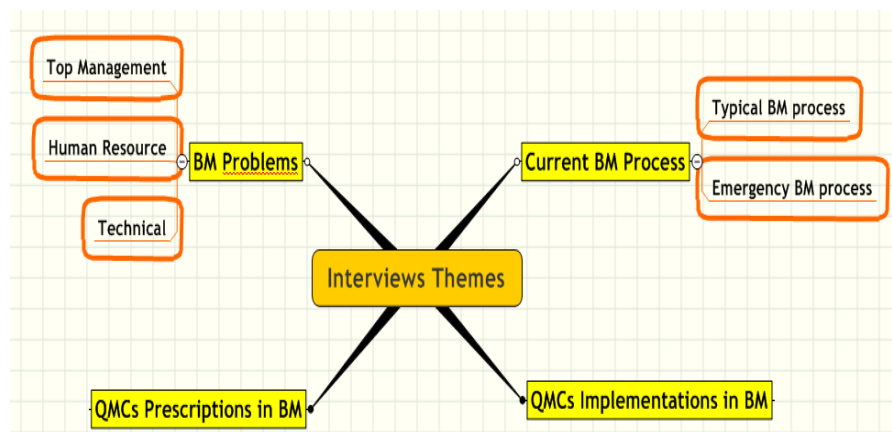


Figure 5.1: Themes and Topics of the Interviews

The second theme explored the interviewees opinions about the common issues and problems that may arise at each stage of the overall process, and on the basis of the responses, the issues identified were categorised into three groups: senior management issues, human resource problems, and technical problems. **The third theme** explored the current awareness of QM in general, and specifically, the five QMCs used in the BM sector. **The fourth theme** explored the influence of QMCs previously applied in the public BM department in Saudi Arabia, and the main barriers to their implementation. This question identified which of the QMCs have been utilised and what problems arose during their implementation. The following sections present the results of these different aspects of the interview questions.

5.3 Interviews Findings and Discussion

This section analyses the textual material obtained from the interviews by adopting the free-flowing text approach, which seeks to distinguish between the analysis of words, and analysis using themes and codes (Bernard, 2010). The interview findings are presented in two ways: firstly, there is the content analysis of the key attributes that surfaced according to the researcher's interpretation; and secondly, there are extracts from the interviews to support the findings.

Theme 1: BM Generic Process

This interviews checked the existing process of BM in Saudi Arabian public departments, concentrating on the key stages supporting the process. The contribution of this section is found in the later development of a generic BM process for all operations and maintenance departments, which will assist in resolving the problems related to maintenance management. There are several business process modelling techniques and tools that can be used to map processes. Business process modelling enables a common understanding and analysis of a business process. A business process is a combination of a set of activities with a logical structure aimed to produce a desired result. In a situation where the existing BM process is being questioned, process modelling is used to identify improvement opportunities in order to complete the work in proper way, more rapidly, and with fewer resources. This is achieved by clarifying the requirements for inputs and output, particularly if a number of different functions (or parts of businesses) are involved in producing the final output.

Process modelling is a major element within Business Process Re-engineering (BPR), which is used to study a business process. In order to explain methods of modelling a process, a number of techniques can be employed, such as: a Data Flow Diagram (DFD), a Gantt chart, a Process Map, an Action Workflow, a Role Activity Diagram (RAD)/Role Interaction Diagram (RIN), and Entity Relationship Attribute (ERA) Modelling, which can address the organisational and functional aspect of a process. For this study, the flow chart modelling technique was selected to illustrate the activities within BM departments, along with the interaction between them, and the rules and procedures and flow of information. It is also important that the tool is able to describe the process in a way that facilitates the owner's understanding of the process.

A block diagram flowchart technique has been identified as a method of describing an existing process by using simple symbols, lines, and words to display activities and sequences in the process pictorially (Harrington, 1991). Figure 5.2 illustrates the symbols used in this study.

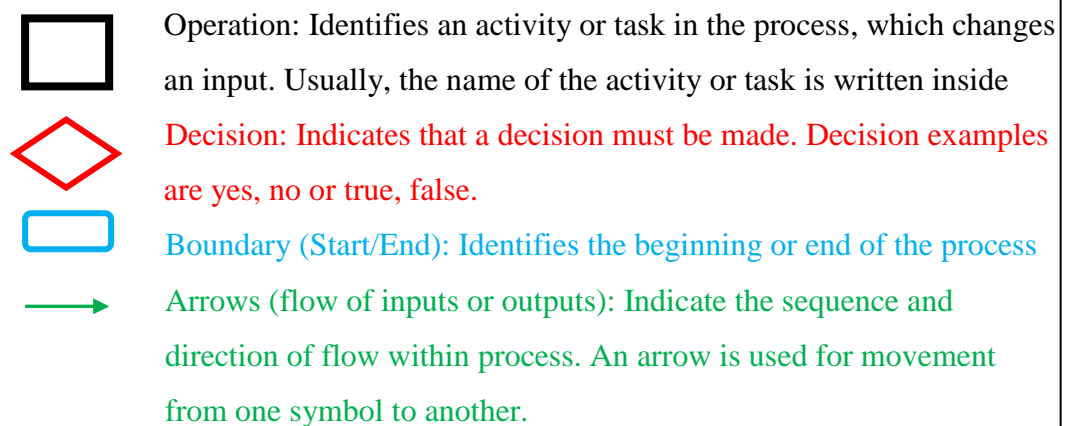


Figure 5.2: Flowchart Symbols (Harrington, 1991; Damelio, 1996)

The researcher developed a conceptual BM diagram based on the literature reviewed in Chapter Two, to be used as a starting point in the interviews (see Figure 5.3).

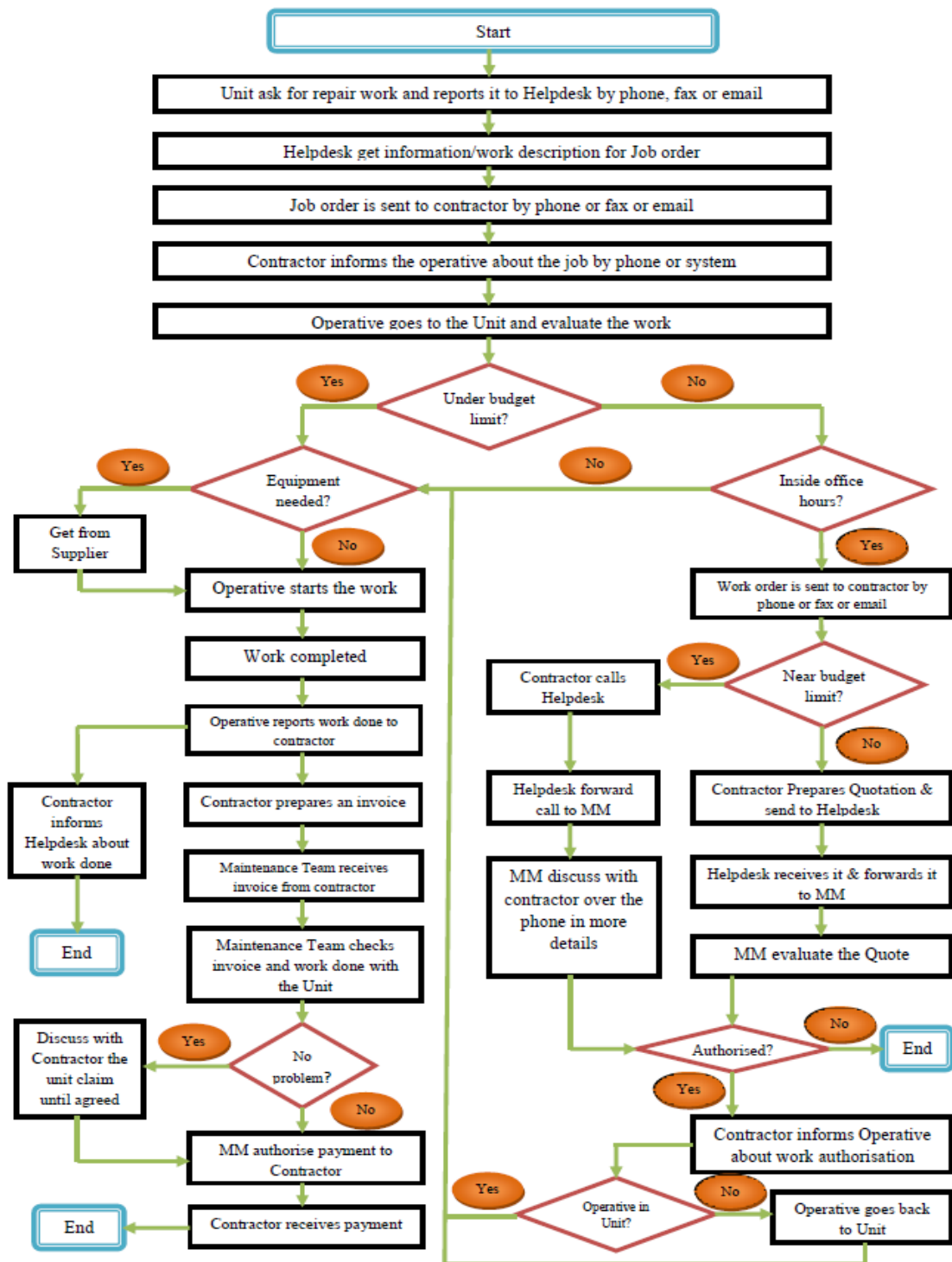


Figure 5.3: The Conceptual BM Diagram

During the interviews, this conceptual BM diagram was presented to the interviewees who were asked to check and modify the diagram to represent the current BM process used in their departments, and after each successive interview, the diagram was modified by the researcher, and then taken to the next interviewee for further evaluation. The idea behind

this strategy was to develop a generic BM process to solve the inherent problems in the process through the use of the most suitable and effective QMC, and then to develop the quality management system accordingly.

An open question about the BM process in public departments was put to interviewees as follows “*What are the BM processes in your department from start to end? Can you give a detailed explanation of the stages and processes?*”

The responses to this question varied in as much as some interviewees outlined the process generally, and some discussed each part of the process separately and gave examples. When all the interviews were completed, it was noticeable that each of the interviewees had placed more emphasis on specific stages of the entire process. This confirmed the complexity of the current BM practice. The analysis consists of an identification of the stakeholders involved, along with an understanding of the business process and the key stages comprising it, and an identification of the different aspects (e.g. technical, management, and human resources) found within the process, including ways in which they could be improved. The refined BM process, as shown in Figure 5.4, consists of the main BM stakeholders and the type of activities and processes that are conducted (arrows linking these stakeholders).

The outline of the generic BM process developed through the answers to this question facilitates both the understanding and implementation of the process as enacted in the Saudi context, and allows for its integration with any quality standards. From this outline, the process diagram for BM was then developed. Figure 5.4 shows the interactions involved between the three different stakeholders: (1) the end users; (2) the maintenance team as client that includes administrators, help desk, and engineers; and (3) the contractor team that includes engineers and technicians, as illustrated in more detail in Chapter Two.

The process begins in one of two ways. The first is when the end user (stage 1) (who is the person works inside the organization) contacts the client (mainly by telephone and occasionally by fax or email) to raise the issue, and provide a description of the problem that has occurred. The Helpdesk (who is working as administrative in maintenance department) is then instructed to issue a new job order, which is forwarded to the contractor for the completion of the job. The second is when the maintenance manager (stage 3) issues an initiative in respect of a corrective or emergency job. The contractor (stage 4) then assigns one of his technicians (stage 5) to deal with the issue.

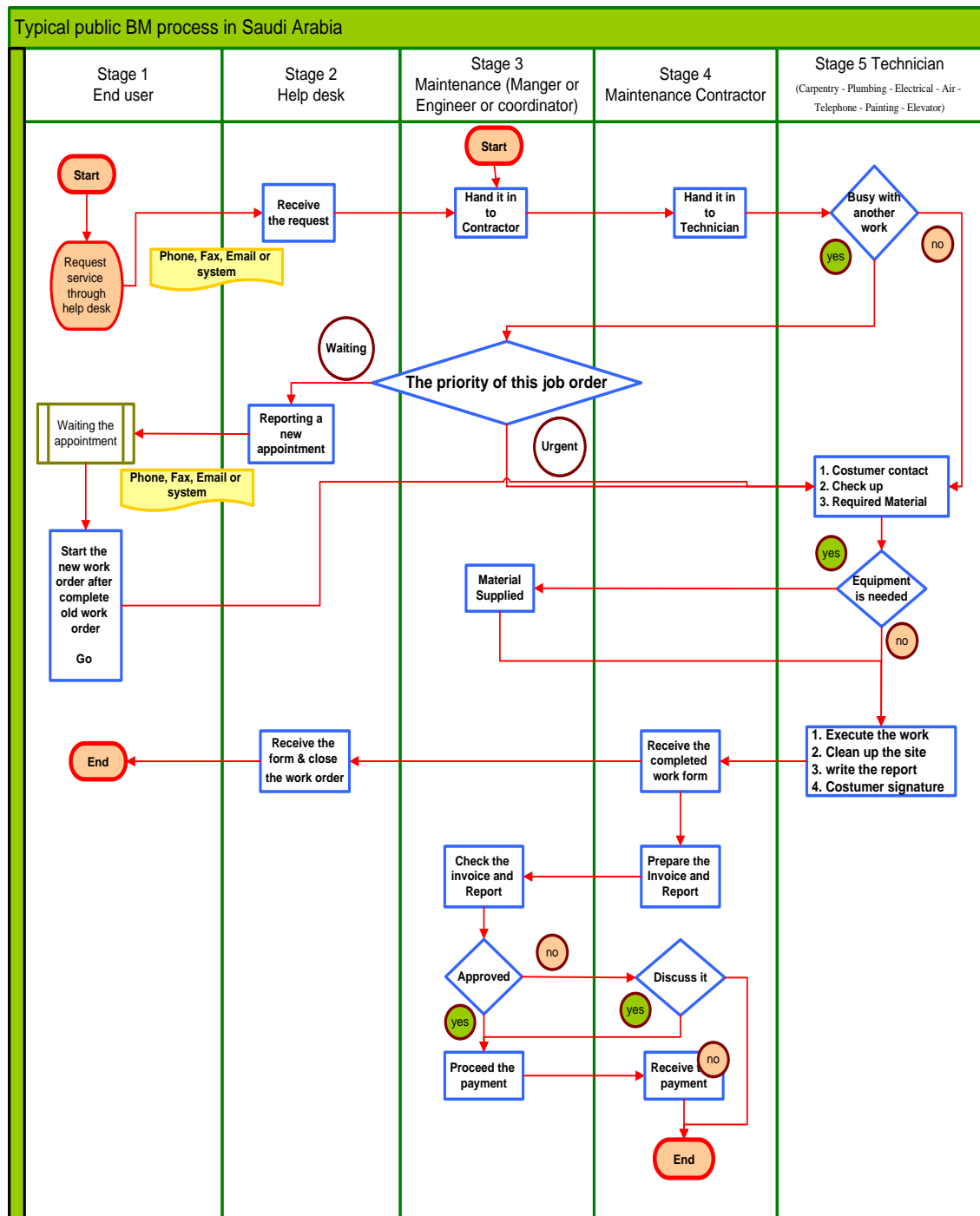


Figure 5.4: Typical Public BM Process in Saudi Arabia

The technician (stage 5) visits the client's unit and makes an estimation of the cost of the maintenance (including materials and labour) before the start of the repair work. The technician checks whether any equipment or spare parts are needed from a supplier and then starts the repair work. In instances where a job requires the authorisation of the maintenance manager, the manager evaluates the estimated cost when the authorisation request is received, and then decides whether the fault is worth repairing. The technician

waits for authorisation to go ahead with the work, and once this is obtained, the contractor informs the technician to start the work. Jobs that fail to obtain authorisation are abandoned, and if the technician proceeds with a job without permission the contractor may not be paid.

The Helpdesk is informed once the repair work has been completed. The end user assesses and evaluates the work, and the work is considered to be completed when s/he is satisfied. Thereafter, the contractor prepares an invoice for payment purposes, the maintenance manager checks the measurements and invoices for any discrepancies, and if necessary, the maintenance manager discusses any issues with the contractor until both parties agree a final cost. Then the contractor can apply to the client for payment. Occasionally, the end user will contact the Helpdesk to follow up the progress of job order reported earlier.

It appears that there is no significant differentiation between the generic BM process discussed in chapter two and the current BM practice in the Saudi public BM industry, in terms of the basic BM process. This similarity is due to most public clients in Saudi Arabia adopting the basic principles of any BM management. However, there is a considerable differentiation in the implementation of those process, due to the different work environment in SA departments. These difference in the BM process are discussed in the next section.

Theme 2: Problems Affecting Building Maintenance Processes

Having established the process followed by the BM departments, the researcher sought to identify the problems associated with operation and maintenance processes in these departments from the perspective of the public sector clients. Building defects arise due to two main reasons: nature and human errors (Low and Wee, 2001). Using the method of thematic analysis, the common problems were categorised into the following three categories: (1) Senior management issues; (2) Human resource problems; (3) Technical problems, within which few sub-categories have been identified as shown in figure (5.6).

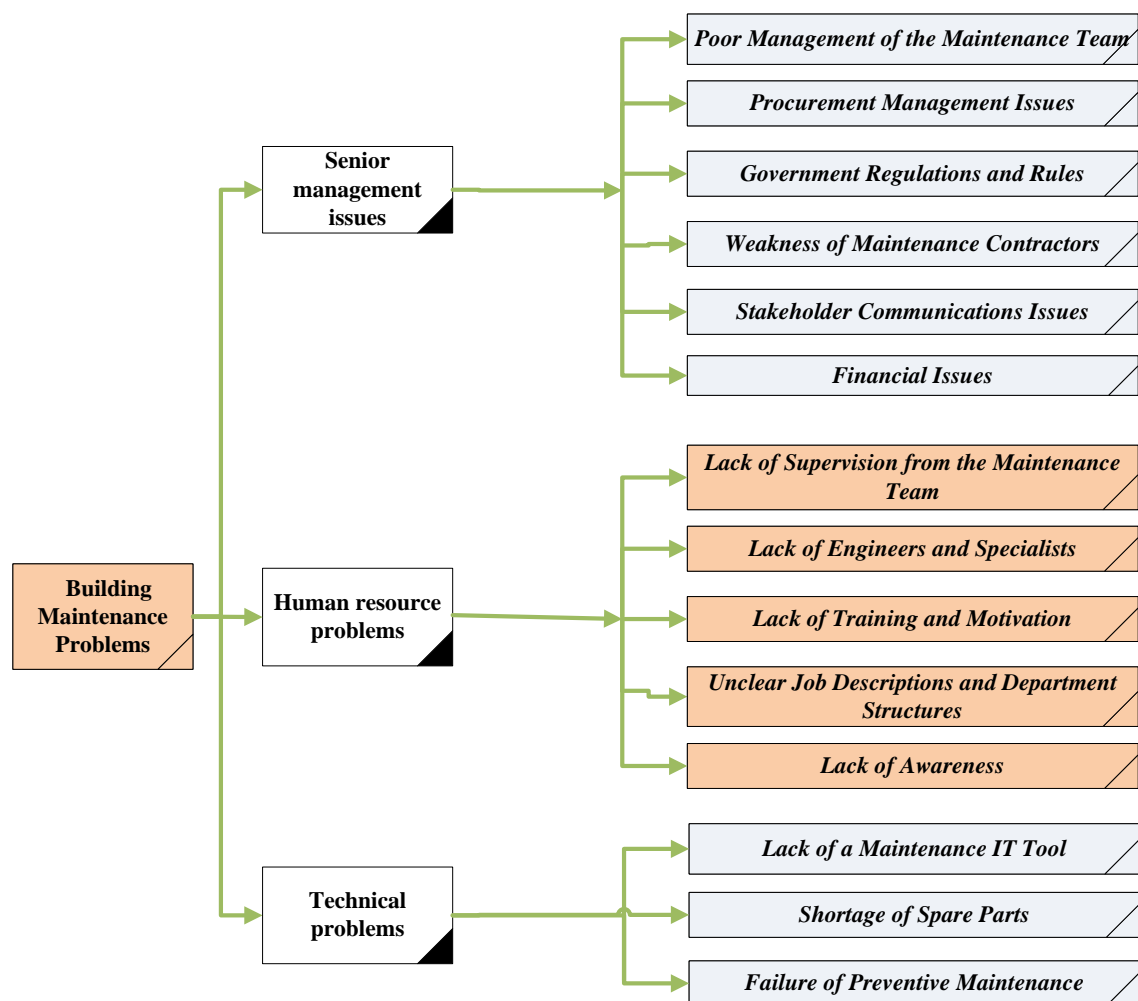


Figure 5.6: Themes of Problems Affecting Building Maintenance

Sub-Theme 1: Senior Management Problems

Significant problems were identified by the management staff from the BM departments as follows:

1. Poor Management of the Maintenance Team

Effective maintenance management is essential for achieving a high standard of maintenance work.

Interviewee 2: *“The main objective of maintenance management is to minimise the need for repair of building defects and operating and maintenance costs by enhancing planning and implementation. The poor maintenance management practices often cause a lot of problems, such as defective building, poor building functionality, and others”.*

Interviewee 4: *“The majority of government organisations do not have any means of measuring performance, while the top level of management works in a non-democratic environment, leading to major delays when it comes to maintenance”.*

The poor maintenance management practices are neither cost effective nor optimum, and often cause a lot of problems, such as defective building, poor building functionality and others. Their support for the BM department is essential. The support provided by the organization enables employees to perform their jobs effectively and productively (Love et al., 1999).

2. Procurement Management Issues

According to the investigated government procurement system, a contractor is required to provide quotations from three different suppliers in order to remedy the problems with a defective building. Quotations are approved based on the lowest price. Hence, it was clear that a major concern of the contractor is cost, with little consideration being given to other issues, such as the quality of the work and on-time delivery.

3. Government Regulations and Rules

The government policy of awarding a contract to the lowest bidder has adverse consequences. The policy fails to consider price fluctuation, or the implications of the fact

that buildings require increased maintenance as they age. The price of spare parts and labour also rises in line with increases in the standard of living and inflation.

Interviewee 6: *“All types of maintenance companies (small, medium and large) are permitted to participate in any maintenance tender, and the company with the lowest price is the winner, regardless of the company profile, resources and quality assurance policies”.*

The method of classification should consider many factors, such as: capital, manpower, experience, equipment available, list of completed projects, quality certificates, etc. Incorrect classification of a maintenance contractor can cause serious problems regarding contractors' ability to execute and complete a project.

4. Weakness of Maintenance Contractors

In Saudi Arabia, public maintenance contracts are awarded based on competitive bidding. A project is generally given to the lowest bidder, who then attempts to complete the work at the lowest possible cost, in order to generate a profit. Thus, two major problems ensue. Firstly, knowing that a new contractor will take over, the previous contractor leaves as much of the work as possible to the new one, in order to save money. Therefore, the final six months of the contract is a loss period for the client. Secondly, at the start of the new contractor's period, the focus is on self-mobilisation and equipment. The majority of the new staff are unfamiliar with the new facility and its procedures, and it is estimated that the new contractor requires several months to become wholly familiarised with the new contracts and thus, to start working effectively, which represents even more loss to the client.

Interviewee 4: *“Governmental maintenance contracts last for three years. Almost six months before the end of a contract, the government department announces for a new maintenance contractor (if the existing contractor's bidding cost was not the lowest)”.*

Contractors who are not always able to provide an excellent team of skilled technicians cause further unnecessary expenditure in terms of time and effort. They may be rejected and replaced with another contractor, which delays the assignment of a new contractor.

5. Stakeholder Communications Issues

In Saudi maintenance departments, they face several stakeholders such as many different departments within the organization with different culture and environment. Maintenance departments tend to suffer from poor communication. There is a need for more coordination to improve the communication event between the team of maintenance department. Ali et al. (2002) argued that in building maintenance projects, a lack of knowledge sharing and poor communication between different stakeholders had caused major problems, such as allocating the right problem to the right contractor, and double handling of data.

6. Financial Issues

In order to ensure the sustainability of a building as it grows older, it is necessary to budget for increasing maintenance costs. However, it is often seen that the deferral or delay of some maintenance tasks occurs because the budget allocated is not sufficient to cover the need for maintenance. It is vital that government budgets include a sufficient financial allocation for maintenance, as this is a critical and unavoidable function. There are also budget constraints imposed by the Ministry of Finance, and year after year the budget is being reduced.

Interviewee 5: *“Many clients allocate only a minor portion of budgets to maintenance costs, i.e. budgeting for and maintaining a facility is considered a secondary obligation, leading to insufficient budget allocation”.*

Interviewee 8: *“The maintenance budget for a particular year usually is based on the previous year’s allocation, plus a percentage”.*

In order to ensure the sustainability of a building, the increasing maintenance cost is needed while the building age is growing older. It is often seen that deferral or delay of some maintenance tasks occurred because the budget allocated is not sufficient to cover the need for maintenance (El-Haram and Horner, 2002). Consequently, further implications such as damage, wear and defect will be incurred. According to Ali (2009), the quality of maintenance activities is influenced by the amount of budget allocation in each task. Budget controlling in maintenance activities is essential to manage the maintenance cost expenditure.

Sub-Theme 2: Human Resources Issues

These are problems caused by the nature of human resources, such as the experience of employees and their attitudes toward maintenance work, which can be classified as follows:

1. Lack of Supervision from the Maintenance Team

A number of interviewees considered supervision as the most critical role in a maintenance department. The majority of supervisors are expected to perform complex management tasks immediately after they are appointed, without any form of training or preparation. Thus, clients are reliant on contractors to perform all maintenance duties, as the government sector does not have efficient maintenance staff for technical duties.

Interviewee 9: *“Public sector companies employ supervisors only, who do not have any technical knowledge. They receive maintenance reports from contractors, who only offer their signature”.*

2. Lack of Engineers and Specialists

The availability of suitable manpower is important in the process of maintenance work, yet in Saudi Arabia, little or no manpower is available locally, and there is a total dependence upon expatriate workers. Consequently, it is vitally important for Saudi Arabia to establish a national workforce that will always be available when needed. There is expansion in the construction of buildings, but there is little corresponding growth in qualified manpower.

3. Lack of Training and Motivation

There is a need to increase the number of institutions and training centres for maintenance in general. The uncertainty and instability of the operation and maintenance industry has created increased difficulty in investing in training employees. It is rare to find a maintenance department manager who allocates a reasonable training budget.

Interviewee 10: *“There is a lack of encouragement for engineers to enter into the fields of maintenance and operation”.*

Interviewee 11: *“Lack of maintenance personnel training is one of the reasons for poor operating practices in maintenance management”.*

Poor operating and maintenance practices often lead to human error and consequently the occurrence of poor quality of maintenance outcomes. Narayan (2003) stated that lack of maintenance personnel training is one of the reasons for poor operating practices in maintenance management. Maintenance personnel or operator's skill is an essential factor that influences the maintenance performance (Pascual et al., 2008).

4. Unclear Job Descriptions and Department Structures

It was noted throughout the interviews that maintenance departments do not possess structured approaches for improving processes, and hence the government sector suffers from a lack of clarity regarding who is supposed to do what. Departments are given different names (such as service management, and support services and facilities), whereas in all public organisations the structure should be the same to facilitate communication, and workers' self-image and understanding of their roles.

5. Lack of Awareness

Understanding the importance of maintenance is vital for both clients and the public in general. Facility clients must be aware of the necessity of maintenance works, so that they can plan, budget for, and finance the work of maintenance in order to keep their facilities in acceptable condition and avoid future breakdowns and failures, which will result in a loss of money and time. Clients must recognise that they need to maintain their facilities periodically and not leave their equipment until the stage of an emergency breakdown, which will cost considerably more than planned maintenance.

Sub-Theme 3: The Technical Problem

There are problems related to the technical aspects of maintenance, which are categorised as follows:

1. Lack of a Maintenance IT Tool

Maintenance departments require effective IT systems to help in decision-making and communications. Such systems assist in determining the ways in which a client's budget is distributed and used during the complete lifetime of the projects, and therefore being benefits when they are in place and used effectively.

Interviewee 3: *"There are no IT systems available for the maintenance, which will lead to help maintenance management".*

2. Shortage of Spare Parts

The absence of suitable spare parts in the local market complicates the process of maintenance works. The recommendation to purchase spare parts is a costly solution to a maintenance problem since this involves the client in spending a large amount of money to procure these as they are not available in the local market. If the local market were able to fulfil this need, the cost of maintenance works would decrease and be quicker to perform as wait times for parts would be eliminated.

Interviewee 1: *“The unavailability of spare parts in the local market causes serious problems, inhibiting the function of maintenance, delaying repair works and increasing the cost of parts, which need to be airfreighted from external markets”.*

Al-hammad et al. (1996) stated that the problems related to the lack or unavailability of the required spare parts, tools or materials to perform maintenance tasks result in poor quality or second hand spare parts are acquired for the maintenance tasks.

3. Failure of Preventive Maintenance

Due to the lack of supervision by the client, and the absence of sufficient engineers, the contractor’s plan for daily maintenance is purely hypothetical that never materialises on site.

Interviewee 5: *“Most of the maintenance departments in Saudi Arabia do not undertake preventive maintenance correctly, due to the fact that corrective maintenance is due daily”.*

Summary

From the above outcomes, the lack of top management, human resource practices and technical issues can be clearly noted. As can be clearly seen, there is a bureaucracy in the public sector which causes many problems. The public client respondents attributed this problem to the lack of training courses for the project team, lack of financial issues, overall management is poor, and there is a lack of effective communication within and outside BM departments, and poor co-ordination with public sector clients and contractors. An important point revealed by the study was that the lack of a contractor team and supervision team led to poor management of BM process. The last point worth noting in

this section is that the lack of engineers and shortage of spare parts was perceived to cause delays in implementing the BM activates.

As discussed in the literature review, it is believed that the implementation of quality management concepts would help in solving most of the above problems that are related to BM industry. The next section (themes 3 and 4) will give a full picture about the current awareness and implementation of these QMCs. After that, these identified BM problem will be linked with the proposed quality management system.

The second research objective - to explore the current awareness of five QMCs in the public sector (i.e. TQM, Six Sigma, Lean Thinking, Lean Six Sigma, and ISO 9001) and the main barriers preventing their effective implementation, is achieved through these findings.

Theme 3: The Awareness and Understanding of QMCs:

The principles of the five QMCs (TQM, Six Sigma, Lean Thinking, Lean Six Sigma, and ISO 9001) were discussed during the interviews, one objective being to evaluate the degree of knowledge and application of QMCs in the BM industry. What emerged as a major observation was an extremely weak level of knowledge and understanding which naturally prevented any effective implementation. The first question asked of the interviewees aimed to assess their awareness of all five QMCs. In response, nine of the twelve participating department representatives indicated that they had no knowledge of any QMCs being implemented during their maintenance processes, whilst the remaining three departments (3), (4), and (11) indicated that they had attended training courses about TQM and Six Sigma. However, regardless of this small amount of awareness shown, not one of the BM departments had implemented any QM initiatives.

Interview 1: *“Honestly, I was not aware of this, but I attended a TQM course for promotion, because in the government sector you must attend some courses to get promotion in your work”.*

Interview 3: *“I do not know about Six Sigma and Lean thinking. In the government procurement system, the price of the raw material comes first and quality comes last”.*

Interview 4: *“I attended courses on the Six Sigma, but the problem is that there is no excellent team to apply them inside the department”.*

Interview 5: *“Public organisations do not request quality certificates or give them preference as one of the conditions to be able to participate in the tender. The contractor with a lower price is viewed the same as the excellent contractor”.*

Interview 6: *“We always hear about quality management. Furthermore, the director of the building supports its application, but it takes time and considerable effort.”*

Interview 8: *“I have attended courses on the Quality Principles, but I have forgotten them. I do not know anything about the application of other concepts”.*

Interview 9: *“I do not know anything about these concepts because there is no training”.*

Interview 11: *“I know about TQM only. Training is not included in the management budget. Without training, an employee cannot work properly”.*

Interview 12: *“I do not know about these concepts, but I have attended a project management course”.*

It can be seen, from the analysis of the exploratory interviews, that the respondents believed that the tasks of the stakeholders involved in public BM in Saudi Arabia are not yet clearly understood with regards to QMCs. These issues must be taken into account in order to manage BM activities effectively. Moreover, analysis of the data also revealed a significant lack of knowledge and experience of the quality management in Saudi BM projects, which led to several problems. Participants in the current study, strongly suggested a need for adopting a quality management system to assist them in overcoming problems and managing BM process effectively.

Generally, there is widespread confusion and misunderstanding concerning what constitutes ‘Lean Management’. Likewise, ‘Six Sigma’ is also relatively unknown, and not properly understood. And whilst quality issues are written into the maintenance contracts, no QM initiatives are in existence. Clearly, for whatever reasons, Saudi BM departments have ignored the need to implement any form of QM. The feedback from the participants regarding the five QMCs in particular, is summarised in the next section.

Theme 4: The Implementation of QMCs

When asked to provide a major reason for not implementing QMCs, most participants indicated that the environment in the government sector did not support any initiative because of the bureaucracy involved in reaching a decision which always took a long time. It was noted that public organisations are bound by regulations that require approval for the implementation of any new concept, and hence, contractors were not asked to implement quality initiatives.

In general, the BM departments in Saudi Arabia are reluctant to accept any formal QMS such as ISO 9000 or any other international standards. A main reason for such a phenomenon is the lack of encouragement or direction from government to do so. Moreover, the problem of limited resources also impacts upon the ability of departments in this respect since the implementation of any formal QMS requires management and monitoring. In fact, several common problems already raised and discussed in Section 5.4 would effect on the implementation of QMCs.

The results show that from the participants' viewpoint, for not implementing QMCs are the lack of effective teamwork, and the lack of skilled and trained workers. Inadequate and insufficient training for employees, and lack of commitment by top management to support quality improvement initiatives were also cited as important barriers. The implementation of any QMC requires resources and demands more paperwork. These are perceived as disadvantages, and there is no tradition of QM department in the public sector. Indeed, in the absence of financial support, such departments would fail to meet their objectives. Clearly, quality is poor because of the government's regulation goes for the lowest price, as this always implies the lowest quality. And a final obstacle is seen as the lack of time available for the implementation of quality initiatives as the techniques associated with these are considered to be too complicated to introduce. Some comments on this overall issue were offered as follows:

Interview 2: *"Our human resources understanding of QMCs are finite, especially for local BM workers".*

Interview 6: *"Training programmes are seen as an added cost for the maintenance department, instead of an investment for the employees, therefore, it is a must for QMCs implementations".*

Interview 9: *“There are no standards or documents to follow”*

It is believed that the implementation of quality management concepts would solve most of the above problems that are related to BM industry. The following section illustrates how the QMCs could assist BM departments to improve their processes.

5.4 Towards Implementing QMC in the BM Process

It has been noted in Chapter Three that the QMCs reviewed are efficient in problem-solving and process improvement regardless of the type of industry. Indeed, numerous studies are reported in the literature on the link between QM practice and organisational performance (Hardwick and Winsor, 2002; Hipkin and DeCock, 2000; Van de Water, 2000). Consequently, the low levels of knowledge and implementation of quality discovered in BM departments in the Saudi public sector are expected to have negative effects on the performance of the BM industry (as discussed in Section 5.4). In an empirical study, Tari and Sabater (2004) show that company quality level and business results, and the degree of implementation of quality tools and techniques are positively correlated. Therefore, Saudi BM departments should be encouraged to systematically implement effective QMCs in their BM process in order to improve the teamwork and people involvement, leadership, and overall performance.

The literature review and previous projects have revealed the clear absence between the linkage of public BM process and the quality management concepts, which negatively influences progress and implementation of BM activities. Consequently, it is necessary to overcome the barriers through quality improvement, and this section clarifies the opportunities for the inclusion of QMCs within the developed generic BM process illustrated in Figure 5.4 in Section 5.3.1, and explains how QMCs can be incorporated into the current BM process. Figure 5.7 shows several such opportunities, which will be discussed in more detail after selecting the most suitable and effective QMC in the next chapter.

The first opportunity can take place in the stage (2) and (3) where a job order being requested, as this stage important to be under control and to be recorded for better coordination and communication and give clear responsibilities for the team. The second opportunity exists in stage (4) where a contractor start his duties to ask the engineer\technician to visit the site for evaluating and submitting a feedback about the

needed repairs, estimating quantities, this stage need to be managed in proper way. The third opportunity is found in stage (5) when the contractor (engineer\technician) ask for a material approval. The fourth opportunity exists in stage (4) where finalised paperwork is submitted. The feedback from the End-user in stage (1) can be documented in this process.

The proposed generic BM process can assist in carrying out these QM opportunities to improve the performance and solve the discussed problems. The QM opportunities will be aligned in the generic BM process based on the principles of QMC that will be explored in the next chapter.

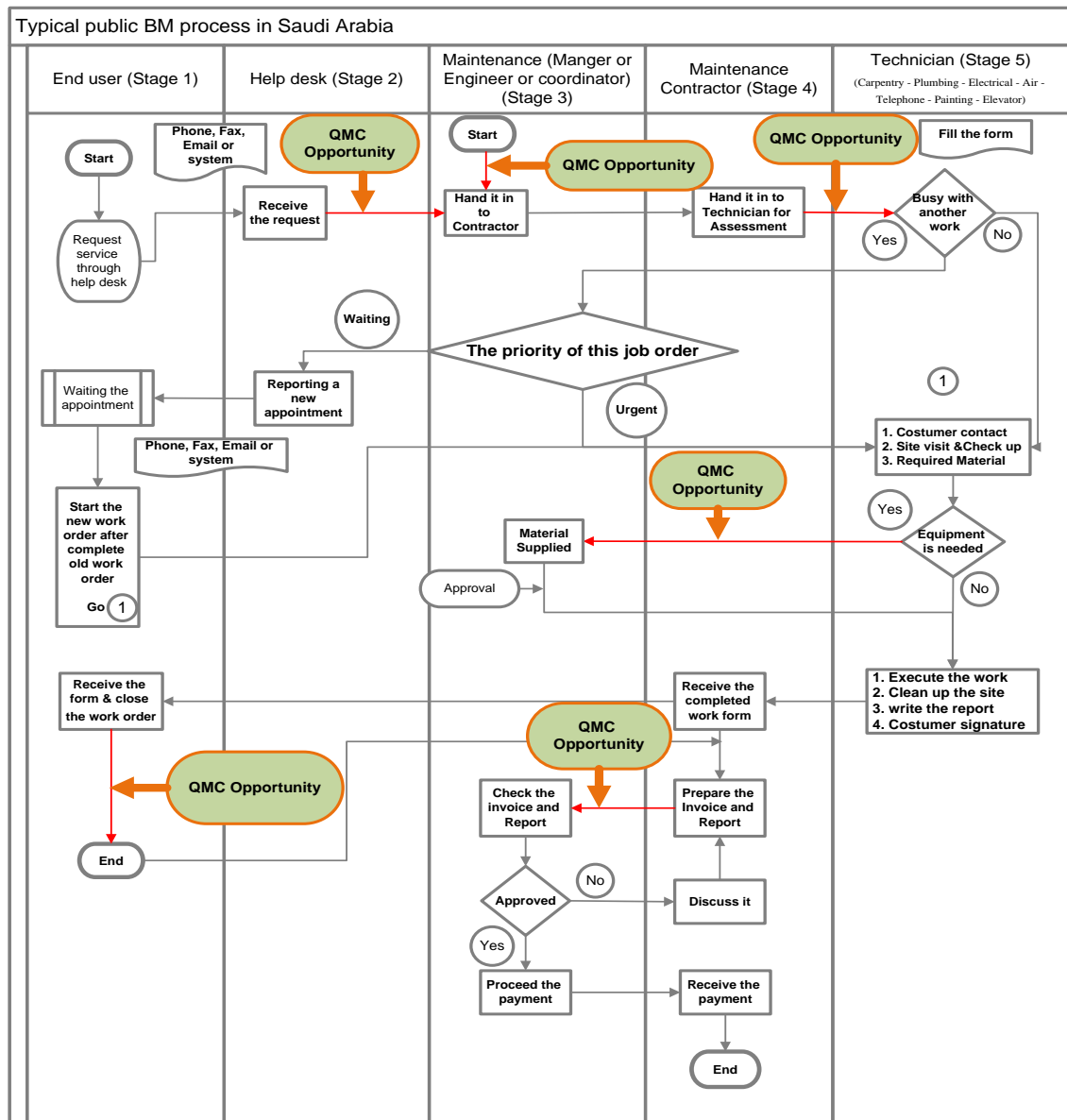


Figure 5.7: Opportunities for the Inclusion of QMCs in the BM Process

5.5 Summary

This chapter has described the data analysis and the findings of the exploratory semi-structured interviews carried out in the Saudi public BM industry. The chapter has given an insight into the BM process followed by public sector organisations in Saudi Arabia, as reported by interviewees in responsible positions in the departments concerned. And from the responses provided by the interviewees, the researcher has developed a generic BM process. Consequently, the problems evident in the process have also been highlighted, and hence, the first two objectives of the research have been achieved.

According to the common building maintenance problems identified, the chapter has shown that there is wide agreement among respondents about the lack of initiative and encouragement from both clients and government to become involved with any form of QMC implementation, and that this phenomenon has led to the low motivation of maintenance departments towards the concept of QM. The majority of interviewees did admit that they were implementing their own versions of quality management. However, in terms of their perception of QMCs, there was a definite misunderstanding among participants of the principles and tools, and a very poor appreciation of how these concepts could be used for problem-solving and BM process improvement. Senior management has been shown to demonstrate little interest or motivation to positively facilitate the further development of QM and provide both managerial/financial support. Their focus is on short-term objectives, and on time and cost required during the delivery of maintenance work.

The next chapter discusses which QMCs have the potential to improve BM practice, as identified through four focus group sessions.

Chapter 6: Exploring Quality Management Concepts

6.1 Introduction

Having accomplished the first and second research objectives, the thesis now considers the results of the Focus Group Sessions (FGS) which were identified by the research methodology in Section 4.3.4, as a means of achieving the third research objective. The purpose of the focus group discussions was to explore and assess the most suitable and effective QMCs for implementation within BM departments, with the intention of improving the performance of the overall BM process. Additionally, these discussions were intended to validate the developed generic BM process (Figure 5.4) presented in Chapter Five. The qualitative stage of the research, as discussed in Chapter 5, with the existing body of literature reviewed in Chapters 2 and 3, revealed several findings in relation to the need for a Quality Management System (QMS) to manage the BM process effectively.

Four focus group sessions were conducted. The participants in the discussion started by evaluating and validating the generic BM process, and then proceeded to identify and select what were perceived to be the most suitable and effective QMCs for the BM sector. This section analyses the textual material obtained from the four focus groups by adopting the free-flowing text approach. The participants gave their views in this respect and the data gathered via this procedure was analysed using a thematic approach as discussed in Chapter Four (Section 4.6). Specifically, the process consisted of two consecutive steps: 1) Categorising the responses for each QMC according to participants' views, and 2) Coding the views according to each QMC so that the codes could be used to generate themes and key points to enable conclusions to be drawn from the mass of textual data gathered from the discussions.

6.2 First Part: Validation of the Generic BM Diagram

As reported in Chapter Four, four focus group sessions were held in a meeting room in a hotel in Riyadh. The members numbered 21 in total, 19 individuals from BM departments and two consultants in Quality Management. Table 4.3 reports the profiles of each of the members, showing their distinctive operation and maintenance backgrounds. Specifically, all were BM practitioners, 12 of whom had already participated in the interview exercise. Some had senior responsibilities, such as directors, and others were in managerial and assistant managerial positions.

The agenda for the FGS was introduced at the start of the session (Appendix B), and the generic BM process as constructed by the researcher from the interview data was then presented to the group with the aim of introducing all the steps within the diagram, from the initiation of the job order through to the end of the process.

All the members in the FGSs confirmed that the structure and the various steps embodied were clear and understandable. Having been asked to evaluate each stage in the process, the majority of members judged the contractor stage as the most important, on the grounds that the contractor is in charge of all maintenance orders. The diagram of the BM process was generally acceptable to the focus group members, and is presented in Figure 6.1 as a validated model, which they all agreed to implement in their own departments. Some of the important comments relating to this topic are as follows:

Interviewee 6 (FGS 1): *“The contractor stage should be the most important one, because he is supposed to develop and improve the maintenance duties”.*

Interviewee 4(FGS 2): *“It would be better including a statement that explain what the next stage is”.*

Interviewee 2 (FGS 3): *“This BM process is something good for us, and we think we need to disseminate this diagram to all staff and stakeholders in the stages”.*

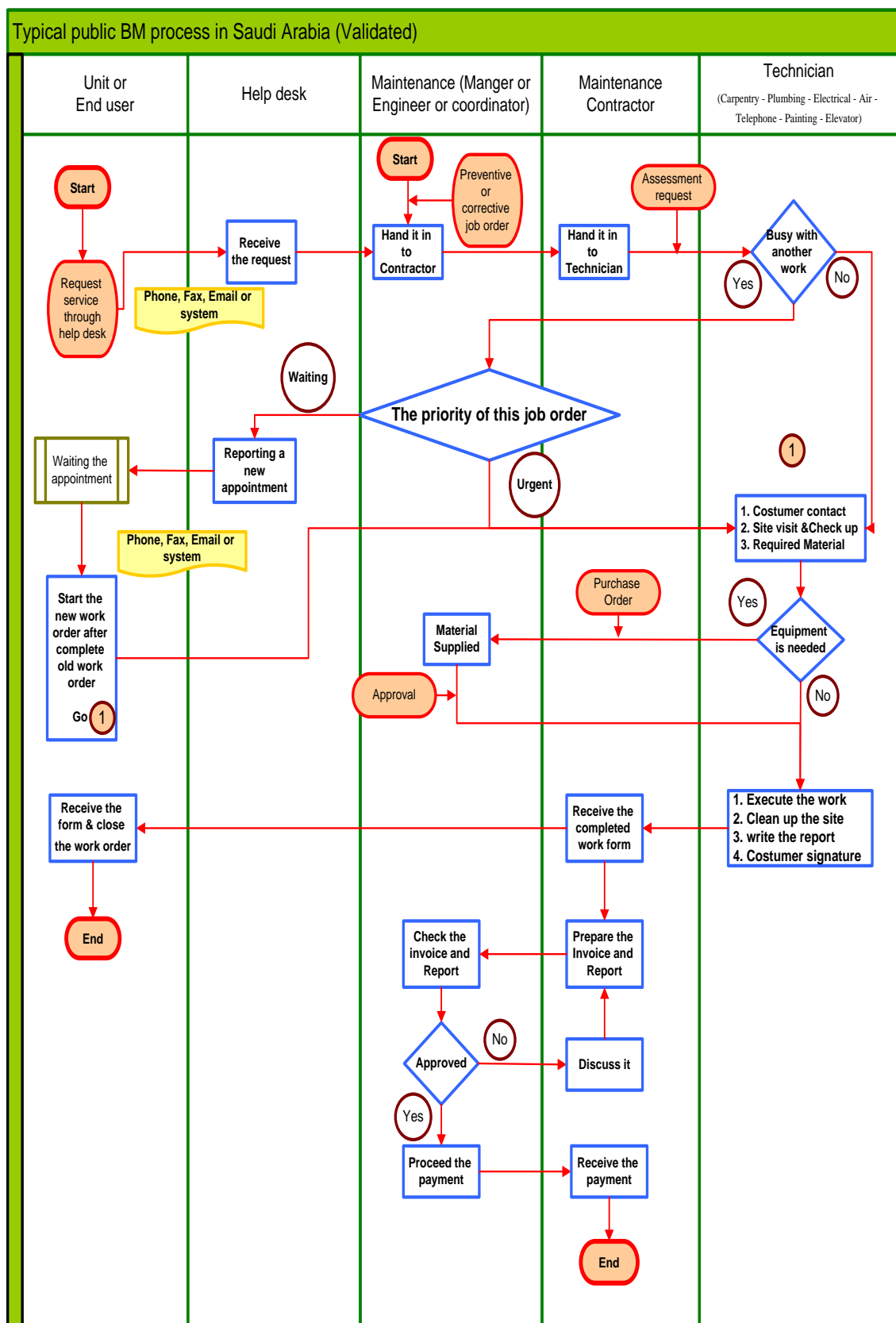


Figure 6.1: The Validated Generic Process for BM

6.3 Second Part: Selection of the Most effective QMC

This exploratory nature of this phase of the study used an inductive approach to elicit knowledge regarding the most suitable and effective QMC for adoption within BM departments as reported in Chapter Four. Five QMCs were discussed within four FGSs namely: TQM, Six Sigma, Lean Management, Lean Six Sigma, and the ISO 9001 standard.

Hence, the researcher introduced each concept in a five minute presentation, and concluded by presenting Table 3.7 that compares the QMCs in terms of theory, process view, approach, methodology, primary effects, and risk and implementation time for further discussion during the FGS. On considering this information, the FGS members indicated that the selection of an appropriate QMC depends on the current situation in the particular BM department involved, and they indicated that a primary concern would be the speed with which the new methodology could be adopted by the organisation. It has been noted earlier in the thesis that the existing literature in the area of BM and QM has not revealed sufficient knowledge about the use of five QMCs in the BM industry within the public sector. Consequently, it was important to gain insight from the BM experts and practitioners within the focus group. The following sections discuss the findings from the respective four focus group sessions.

The aim of focus group sessions was to identify the most suitable QMCs for BM and learn how it can be implemented. The overview of the four focus group sessions presented below.

6.3.1 First Focus Group Session

The first focus group session was comprised of seven participants (Figure 6.3), including among them, five heads of maintenance departments in the public sector, each with more than 20 years' experience see table (4.7). The additional two participants were QM consultants as discussed in Section 4.3.4.

The group was created as a homogenous one so that members had the same levels of seniority and experience, would be able to understand each other, and would be able to

approach the discussion from the viewpoint of heads of department with heavy responsibilities.



Figure 6.2: First FGS

The participants who took part in this focus group session participated in the interviews stages. Seven participants were selected in this group as recommended in literature, which indicates the optimal number for a focus group as being between six and eight people (Morgan, 1996), as discussed in section (4.7.3).

6.3.2 Second Focus Group Session

A second focus group was held to accommodate six of the practitioners who had participated in the interview exercise and expressed an interest in attending such a discussion. The participants who took part in this focus group session were identified from the researcher's experience and colleagues' recommendations. The participants were identified via the snowballing technique. Consequently, the second group contained eight members, these six practitioners, and two QM consultants. Of the practitioners, four were directors of BM departments, and two were assistant managers as detailed in Section (4.3.4).

6.3.3 Third Focus Group Session

The researcher arranged the third focus group session because it was not yet felt that the data had become saturated since there were new and different opinions being expressed in the first two group discussions. The number of members was smaller than the first two groups, however, there being five in total, consisting of two managers, one assistant

manager, and two QM consultants as detailed in Section (4.3.4). The participants emerged as a result of the snowballing technique, with all of them being recommended by previous participants who had taken part in either the first or second focus group sessions.

6.3.4 Fourth Focus Group Session

The fourth focus group session was intended to achieve saturation, and hence, lead to the discovery of what leads to select the most effective and suitable QMS in BM industry. Morgan (1996) has suggested that diversity in either the participants or the range of topics covered in focus group discussion increases the number of sessions necessary to achieve saturation, and for this reason the researcher conducted the fourth as a final group session. As indicated in Chapter Four, the optimum number of focus group sessions depends upon the nature and complexity of the subject under investigation and the use for which the data generated by the focus group sessions is to be employed. From one to ten sessions are generally suitable for most studies (Powell and Single, 1996). Hence, given the emergence of the data, four were believed to be sufficient. At the fourth focus group session, there were six participants, including one QM consultant as detailed in Section (4.3.4).

6.3.5 Saturation Point

It can be appreciated that the fourth focus group session consolidated the data obtained in the earlier focus group sessions and ensured that any remaining facts not previously identified, were brought to light. Form these four focus group session, nineteen participants with average of fifteen years' experience were invited to contribute.

In the fourth focus group nothing new was emerged. All participants in this final focus group emphasised that same data and interpretations already gathered from the previous focus group sessions. Therefore, it was concluded that the data had reached the saturation point, and that the emergent themes can be developed as shown in Figure 6.4.

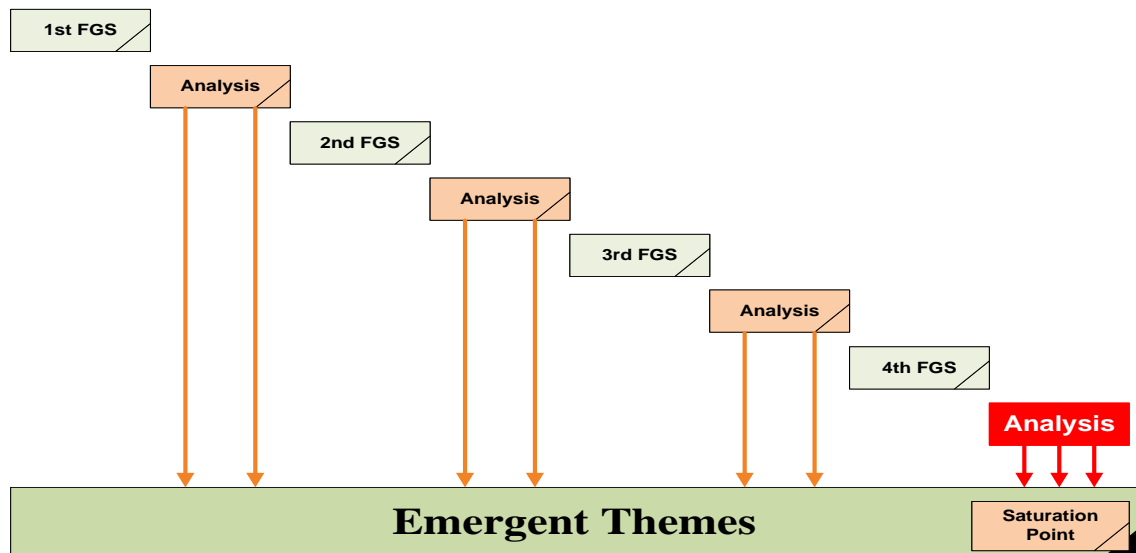


Figure 6.3: Development of Emergent Themes

Clearly, the focus group methodology accumulates a great of amount of data, but the researcher must decide what is important to the precise objectives of the immediate study, and in analysing that data, the researcher continually focused on that need. This is not to say that data that might have not been entirely relevant to the study's objectives is worthless, since there are opportunities for exploring this data to validate the earlier objectives that were investigated. The analysis of codes (thematic analysis) is employed to the data collected from the focus group sessions. Thematic analysis provides core skills that will be useful for conducting many other forms of qualitative analysis (Bernard, 2000). Indeed, Corbin and Strauss (2008) argue that thematic analysis is the most useful approach for capturing the complexities of meaning within a textual data set. It is also the most commonly used method of analysis in qualitative research. Next section illustrates the emergent themes from the four FGSs.

6.3.6 Emergent Data from Four Focus Groups

The discussion within the FGS mainly covered two themes for each QMC: Theory and Implementation. Figure 6.5 shows the focus group themes and criteria for selecting the most suitable and effective QMC.

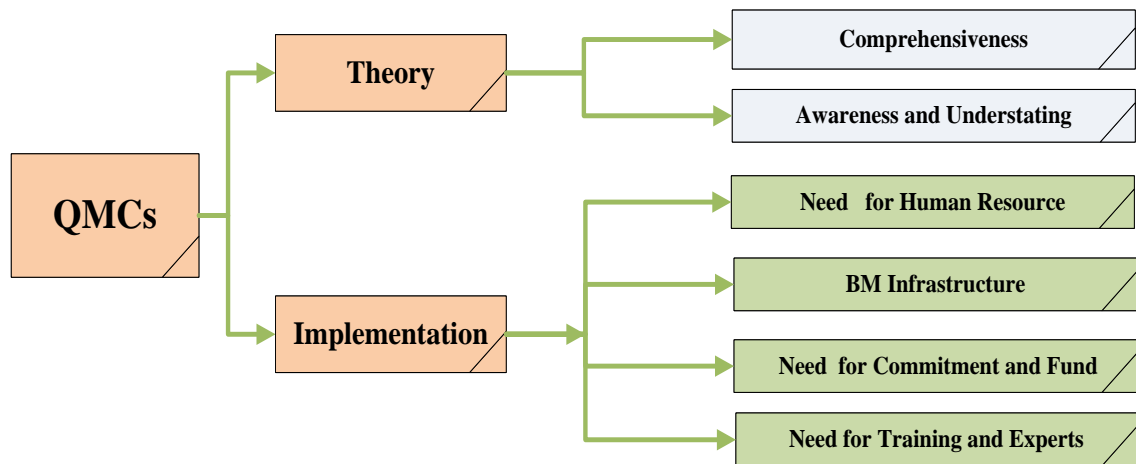


Figure 6.4: Themes from the Focus Group Sessions

Each of the criteria (themes) related to each QMC is individually described in the following section, along with quotes from the participants. It should be noted that not every participant spoke about each theme of these criteria; it may be that some did not see any of these themes as relevant.

QMC 1: TQM

The first QMC introduced was TQM.

Theme 1: Approach of TQM

It can be understood that TQM is a top-down management philosophy focused on monitoring the process, employee involvement, and seeking continuous quality improvement in order to meet customer needs. It can also be appreciated that TQM involves all people in all functions, and at all levels. The theme that emerged from this criterion is detailed below.

Criterion 1: Comprehensiveness

In their consideration of TQM, participants believed this could be applicable if a system of in-house maintenance were adopted, because in that situation it would be possible to lead and manage the whole maintenance team, since that team in its entirety would be reporting to the director of the maintenance department and this could help to focus on the process in a proper way and have a positive effect on customers. However, Participant 5 in FGS (2) said that *“Being a comprehensive approach, it requires the ability to control the maintenance contractor, which is not possible when outsourcing.* Moreover, it was

commented that *“the implementation of TQM was difficult because it is very tedious, and it is not worth the time.”*

Participant 2 in FGS (3) said *“A lot of efforts is needed to apply TQM, that includes high level communication and coordination between all people involve in BM operation,”* and Participant 4 in FGD (2) said *“TQM need The participants in the discussion started by...as identifying and selecting and perceiving are concrete activities that can only be undertaken by people.s involvement from all people and more processes, so the more complicated you will get,”* and he also said *“All specialist staff should get full awareness and knowledge of quality management.”* Participant 1 from FGS (4) further pointed out that *“to involve all people to implement TQM you need to educate and support them, this causes a huge cost and a long time.”* Participant 3 in FGS (1) argued that *“TQM would not be suitable just for the maintenance department, as the overall philosophy was that the concept should be applied to entire organisations for it to work, and in this respect it is difficult to maintain because of the need to educate all employees within an organisation, and subsequently control their behavior.”*

Participant 6 in FGS (1) said that *“TQM requires good communication and good relationships with other departments”,* but it was noted that *“this would present a genuine difficulty, as the current situation did not involve the maintenance department sharing information, even within the department itself, let alone, across the organization.”* Regarding TQM, it was agreed that it is difficult to implement because, in reality, its success depends upon people’s interest and behaviour. For example, in a maintenance department, one section may work hard while the other sections do not. However, the Saudi government’s policy is to outsource its maintenance requirements, and hence, the majority of participants indicated that in the current BM environment with unqualified contractors, TQM would not be applicable.

Dala and Cooper (1992, p.11) state that *“TQM is a much broader concept, encompassing not only product, service and process quality improvement but those relating to cost and productivity, and people involvement and development.”* As TQM is so comprehensive, one can easily see why TQM as a concept is often misconstrued. Many organizations view TQM as a quick fix to all the ills that have caused poor performance. However, TQM is not an easy solution to organisational problems, but rather an approach to managing an

organisation which is based around continuous improvement and cultural change (Kanjilal and Asher, 1996).

Criteria 2: Awareness and Understating

Total Quality Management is a crucial topic. One of the main causes of failure to improve BM project goals is inadequate knowledge and understanding of TQM. Participant 2 in FGS (3) expressed the view that there is a lack of TQM awareness in the BM industry, saying that: *“in the current situation without increasing the knowledge of TQM for all related staff in the project, we would not be in a position to implement TQM in an appropriate way.”*

Participant 6 in FGS (1) said *“All specialist staff should get full awareness and knowledge of TQM through training and educating them,”* In regard to TQM, Participant 3 in FGS (2) raised *“the difficulty of implementing this in the public sector because of the lack of awareness and commitment from top management.”* Participant 3 in FGS (3) discussed *“The problems of the need for training among the entire workforce and of raising workforce awareness of the TQM culture which were also obstacle, as was the issue of such training not being part of the maintenance departments’ strategic plans.”*

In the context of the BM industry, it was seen that an overwhelming lack of awareness was evident both among supervision teams and contractor teams, and within organisations. Hence, there was seeming large-scale ignorance of TQM as a concept, and this validated and confirmed the outcomes from the interview method. All practitioners cited lack of awareness as a serious problem preventing effective TQM in BM projects in SA. According to Gilson (1995), awareness is often defined in terms of knowledge: of being familiar with certain facts; of being ‘informed’.

Theme 2: Implementation of TQM

The implementation of TQM principles in BM department is influenced by the four criteria discussed below.

Criterion 1: Human Resource Need

In the context of TQM methodology and implementation in BM projects, resource allocation is the provision of resources required by BM activities. In an organisational

context, resources are comprised of people, materials and equipment, and knowledge and time.

There is need for people to be involved in the BM project who are responsible for managing BM activities in a direct or indirect way, such as the supervision team and contractor team. These people are considered as key players within the BM activities, and a viewpoint expressed was that more focus should be placed on them. Participant 3 in FGS (1) expressed the opinion that *“TQM methodology requires a large supervisory effort to ensure the process and procedures are being followed.”* And Participant 5 in FGS (2) indicated that *“TQM might be applicable to contractors, because they have tools and human resources but that it would not be effective for the client.”*

The implementation of TQM generally requires major resources, including human resources and funds (Kelly, 1992; Shin et al., 1998; Latino, 1999). Since management is responsible for the availability of resources and the overall implementation approach, management commitment is a prerequisite for successful implementation. Torrington and Hall (1995, p. 314) state that *“difficulties experienced in adopting TQM have mainly focused on people issues.”* The responsibility for TQM is shared amongst all members of an organisation. TQM focuses on employee involvement in the control of quality in organizations (Levy, 2003).

According to Robertson (1994), it is the employees that create change, support change, and in the end, affect the longevity and success of the organizational technique. Specifically in the case of TQM, employee behaviour is an integral part of changing quality (Flores and Utley, 2000). The role of employees is a very important aspect of the implementation and success of TQM. Daniels (2000) believes that the behaviours of people in business are the centre of every business decision and are what underlie every process in organizational change.

Criterion 2: BM Infrastructure

In this respect, it can be understood that the attempt to apply good TQM practices, may not be successful in an environment that remains in a state of unreadiness, as is the case in Saudi Arabia, Participant 4 in FGS (1) said *“the maintenance department infrastructure to support the operation of those practices, such as a strategic plan, building codes and a clear corrective maintenance plan do not exist. As result, maintenance teams will simply*

be demotivated as they try to implement TQM practices that do not have a chance of being successful.” Participant 2 in FGS (2) observed that implementing TQM is a lengthy process,” and added that “if there is no clear structure for a department it is not possible to apply and maintain TQM.” Participant 4 in FGS (3) said that “lack of safety and quality process and procedures are caused by the lack in maintenance contracts.”

An effective maintenance strategy is one that fits the needs of the business. Its performance is judged based on certain measurable criteria. Cholasuke et al. (2004) categorized the maintenance effectiveness measures into nine areas under the structural and infrastructure elements such as: policy deployment and organization; human resources management; financial aspects; continuous improvement; contracting out maintenance; maintenance approach; task planning and scheduling; information management and CMMS and also spare parts management.

Criterion 3: Need for Commitment and Funding

One of the main reasons for not implementing TQM effectively emerged as the lack of commitment and funds provided by the senior management in organisations. On this issue, Participant 3 in FGS (1) commented that *“appropriate funds and support to related BM managers should be adopted to reach a suitable maturity level of TQM”*. This would enable greater initiative on the part of employees to promote more effective TQM implementation. The role of senior management was stressed by Participant 4 in FGS (2), in the comment *“By now you should understand that effective TQM implementation needs more and more support and commitment from the top management.”* It is clear that these participants believe that the success of a TQM program first of all depends on top management practices. Participant 4 in FGS (2) said *“Only if supported by this commitment and understanding, can senior management lead the organization toward the realization of higher quality in its undertakings.”*

TQM is a culture and philosophy that must permeate an organization as the method of management. It can thrive only under a senior management that establishes TQM as a top priority. This commitment must be coupled with a thorough understanding of TQM. Without this understanding, management's action will most likely contradict TQM, confirming the doubts of the labour force and dooming the effort to failure. If TQM is to be successful in an organisation, it must be actively supported by senior management.

Schein (1991) identified one of the common causes of failure of TQM programmes as a lack of top-down management or involvement of top management. Further, TQM is a management philosophy that seeks to integrate all organizational functions to focus on meeting customer needs and organizational objectives (Hashmi, 2000-2004).

Criteria 4: Need for Training and Experts

Training is the foundation required for raising TQM awareness. Commenting on this issue, Participant 5 in FGS (1) said: *“Training related people will not only help in achieving the project goals and improve their skills, but also will raise the department awareness, in order to reach the ideal TQM implementation,”* and Participant 1 in FGS (2) supported this view, saying *“ongoing training in TQM is important for all professionals working in a BM department.”*

The need for TQM experts was further emphasised by Participant 1 in FGS (1), who said: *“I think that the organization needs to pay for TQM experts to teach BM Team is important.”* Additional confirmation of the importance of this aspect comes from Participant 4 in FGS (2), who said: *“The training of people in BM activities can help to ensure achieving the effectiveness of TQM implementation.”* Further, Participant 4 in FGS (1) complained that *“there is no training provided in-house to ensure that employees get familiar with processes and techniques of TQM.”*

It is clear from the practitioners' statements that one of the main reasons why TQM is not implemented effectively is the lack of staff training. Therefore, one can argue with confidence that TQM must be supported by training programmes for the relevant individuals, for example supervisors, managers, directors, and executives. Training implies activities that develop employee competence, skills and knowledge (e.g. Nakajima, 1988; Thomes, 1994; Bardoel & Sohal, 1999). Training promotes employees' belief that the organization is investing in them; it also supports understanding and awareness. Its importance is recognized by every quality expert. Under TQM, quality becomes everyone's responsibility and the training must be targeted at every level of the company.

Summary

From the analysis of the data collected from practitioners in regard to TQM, the lack of awareness of and commitment to TQM, accompanied by training and funding can be

clearly noted. Some respondents declared that insufficient BM infrastructure and poor management affect the selection of TQM as a suitable QMC in the current public BM industry in SA. To implement a TQM program, Levy (2003) recommends four necessities. First, the support of top management must be sought and senior management must receive training on what TQM is, how it operates, and what their responsibilities are for effective implementation. Secondly, employees need to be trained on quality methods. Even the lowest level employee is empowered to take steps toward quality improvement, when and where necessary (Jex, 2002). For effective TQM implementation, for instance, all employees should have access to quality control data and be encouraged to act on problems related to product quality. Thirdly, employees are also expected to be trained in the processes and procedures of TQM. Such training should centre not only on identification of areas in which the department or division excels, but also areas of deviation from quality standards (i.e. errors). The fourth goal is self-comparison analysis, whereby the organization compares its effectiveness to that of the competitors who used to set the goals or benchmarks. The last point worth noting in this section is that as a comprehensive system was perceived to be ineffective QM in BM department in SA.

QMC 2: Six Sigma

The second QMC introduced was Six Sigma. In this respect, the QM consultants followed the researcher's overview by providing further insights regarding possible approaches, effects and implementation from a practical perspective. It was evident that most of the participants had never heard about Six Sigma, so it was necessary to provide substantial detail to ensure they understood the concept and were able to give informed feedback.

Theme 1: Theory of Six Sigma

Using a disciplined approach to process improvement, a team of stakeholders in the subject process systematically applies what Six Sigma calls DMAIC.

Criterion 1: Comprehensiveness

The participants believed that the Six Sigma concept could be applicable for specific maintenance of elements such as elevators, the fire system etc. this could help to reduce the deficiencies in the maintenance activities. The Six Sigma concept, enables the reduction of variations in the process, eliminates the occurrence of errors, and reduces the time cycle of the maintenance process. Participant 1 in FGS (1) thought that *“Six Sigma could be implemented in technical areas (mechanical, electrical) but not in general*

management.” In respect of its potential for technical improvement, it was considered by Participant 2 in FGS (1) that *“the approach could help to monitor the lifetime of machines, which would be helpful because, currently, proper maintenance is not performed, as there is no IT tool to measure and analyse the performance of machines.”*

Participant 4 in FGS (1) provided the best example, saying that it could be helpful *“in a water treatment plant, since the implementation of Six Sigma could limit concerns about failures in water production and help identify errors and defects at the treatment plant processes for maximising equipment operational effectiveness.”* Hence, the Six Sigma approach was believed to be applicable to guarantee the quality of equipment, but not for improving the quality of the management process and procedures. Indeed, Participant 3 in FGS (3) did say that *“the first time we have heard about the concept, it is hard to properly make a judgement, and definitely too early to consider applying Six Sigma”*. Additionally, Participant 1 in FGS (4) said *“In fact, it is believed that at present there are no benefits to be gained from Six Sigma because the concept has resource implications and the shortage of staff and software precluded its implementation”*.

Clearly, there was a level of interest in Six Sigma but the group was in agreement that now was not the right time to attempt to implement it for a variety of reasons. One such reason was the difficulty of methodology in getting people to become familiar with the use of software applications for maintenance duties. The second reason is the need for training and experts, as discussed in the next theme. Six Sigma methodology is also used to address maintenance actions directly.

Criteria 2: Awareness and Understating

It was evident that most of the participants had never heard about Six Sigma. Thus, creating awareness of the need to change the existing maintenance concept by abandoning old modes of thinking was a vital requirement identified by the participants. Participant 1 in FGS (3) expressed the view that there is a lack of six sigma awareness in the BM industry, saying that: *“practitioner’s awareness of six sigma is not mature enough to adopt this quality management system.”* Participant 5 in FGS (2) raised the point that *“It is necessary to attract the top management’s awareness and to empower the employees. Six Sigma should be promoted as an excellent tool for generating new ideas in a structured manner.”* Nevertheless, the results demonstrate that due to the low awareness of six sigma

and implementation issues, as well as a lack of management experience and knowledge, external help is required for BM departments..

Theme 2: Implementation of Six Sigma

The Six Sigma methodology is the implementation of a measurement-based strategy, which focuses on improvement of a process and sub-processes through the application of Six Sigma best practice methods, such as DMAIC (Define-Measure-Analyze-Improve-Control). Based on the analysis results, it will also provide strategies to eliminate the variations within the process in order to provide consistent quality, so that, ultimately, the corporation will be able to solve its problems and to increase its competitiveness.

Criterion 1: Human Resource Need

In the discussions, a viewpoint was expressed was that more focus should be placed on them the people who are considered as key players within the BM activities. There is need for people to be involved in the BM project who are responsible for managing BM activities in a direct or indirect way, such as the supervision team and contractor team. Participant 1 in FGS (1) said *“adopting the DMAIC method needs clear roles and responsibilities for team members to apply Six Sigma and master black belt as a lead for this initiative,”* and Participant 5 in FGS (2) indicated that *“TQM might be applicable to contractors, because they have tools and human resources but would not be effective for the client.”*

In implementing the six sigma quality management system, the corporation should select dedicated staff to apply the necessary statistical, quality management, and communication techniques for promoting the six sigma project. The staff of the improvement project team should be hired as full time employees dedicated for the improvement project. The dedicated six sigma staff play the key role in determining the success of the promotion activities. Any quality improvement implementation like six sigma requires top management commitment and provision of appropriate resources and training (Halliday, 2001). Six Sigma should be part of everybody's job, including top management and senior managers. Without the top management and support, the true important of the implementation will be in doubt and the energy behind it will be weakened (Pande et al., 2000).

Criteria 2: BM Infrastructure

Because Six Sigma programs rely on measurements from processes, organizations with robust measurement systems in place are more likely to be ready for a Six sigma implementation (Hensley and Dobie, 2005). Six Sigma's use of statistical methods allows organisations able to understand fluctuations in a process, which then enables them to pinpoint the cause of a problem. Participant 6 in FGS (1) commented that *"the implementation of this approach require documentation and software tools to analyse the data, and that unfortunately, such tools of analysis are not available in most public maintenance departments."* Additionally, Participant 5 in FGS (1) noted that *"even if the right software tool exist, there are no qualified staff to use it and would be hard to enter the huge daily data for all BM activities."* Participant 4 in FGS (2) said *"there is a need for data collecting, data analysis through IT tools to apply this quality concept to report about the current BM situation"*. Participant 2 in FGS (3) said *"Although the six sigma effect saves money, in maintenance contracts there is no requirement for contractors to use IT applications to improve their maintenance performance and this suggests that additional budgets would be required for its adoption which would be an additional drawback."*

Concerning the potential for implementing Six Sigma, Participant 2 in FGS (1) believed *"it would be difficult to reduce maintenance costs through this concept, because in the current situation, preventive maintenance is either neglected or not performed properly."* Furthermore, the lack of an IT software application within the departments was felt to be a large obstacle to the introduction of Six Sigma. Six Sigma is based on statistical process control concepts, and thus uses sigma measurement in ensuring conformity to specifications (Bendell, 2000).

In the current status, the participants felt that the implementation of Six Sigma through following the DMAIC method: define, measure, analyse, improve, and control would not be successful. The Six Sigma is a process-focused system. It requires a process analysis based on the current process flow. However, as Participant 4 in FGS (1) said, *"the maintenance department infrastructure to support the operation of those practices such as strategic plan, building codes and clear corrective maintenance plan does not exist"*. There is a specific terminology for employees who are involved with Six Sigma which does not exist in the nomenclature for current BM activities, which includes terms such as: sponsors, who are responsible for promoting and defining the programme directives,

sponsor facilitators, who exercise the main function in project development and champions who carry out project management. These are followed by the other members of Six Sigma, who are distinguished according to their levels of knowledge and training, and for whom the following denominations are used (Ingle and Roe, 2001): black belts, green belts, yellow and white belts.

In addition to top management, there also needs to be an effective BM department infrastructure in place to support the Six Sigma introduction and development programme. The employees should be highly trained, have undergone rigorous statistical training, and lead teams in identifying, executing and managing Six Sigma projects. Managers facing challenges due to the implementation of Six Sigma need to understand this requirement. Also needed are a clear communication plan and channels to motivate individuals to overcome resistance and to educate senior managers and employees on the benefits of Six Sigma (Kwak and Anbari, 2006).

Criterion 3: Need for Commitment and Funding

Any Six Sigma initiatives require commitment and funding provided by the senior management in the organisation. The key ingredient for a successful Six Sigma management process is the commitment of top management. Additional investments in production facilities might be needed for changes and improvements in the process flows. The Six Sigma quality management activities depend on the staff, corporate organization, and the leadership of senior executives. Therefore, the ambition and aggressiveness of the senior executives are the prerequisite factors for corporations to implement the Six Sigma quality system. On this issue, Participant 3 in FGS (1) commented that they would “*need appropriate funds and support to related BM managers should be adopted.*” Participant 4 in FGS (2) said, “*Only if supported by this commitment and understanding can senior management lead the organisation toward the realization of higher quality in its undertakings.*” There are a variety of important success factors for Six Sigma programmes. These range from generic issues such as senior management commitment (Breyfogle 1999), to employees, on their part, making sure that they study, use and appreciate the methodology to ensure successful implementation. This can be achieved by attending training courses conducted by the organization, self-study, enrolling in external (certification) courses or a combination of the above.

Top management commitment (Coronado and Antony, 2002; Goh, 2002) is most important. Almost all the literature reviewed agrees that this factor is a must for successful Six Sigma implementation. This has to be “top-down” rather than initiated by a particular department or from the ground (Goh, 2002). Top management involvement helps to influence the cultural change in attitudes of individual employees and restructure business organizations towards quality in a short implementation period (Henderson and Evans, 2000).

Theme 4: Need for Training and Experts

The Six Sigma quality system requires that participants in this project should receive educational training to enhance their statistical skills and quality management techniques. Using individuals called Green Belts, Black Belts or Master Black Belts, highly trained in the tools and principles of Six Sigma, organisations can focus resources on underperforming processes to achieve high-leverage results. Participant 3 in FGS (1) said *“There is a serious shortage of training for individuals involved in BM projects, and the maintenance contractor used to ignore any special training to improve quality.”* Participant 5 in FGS (2) said *“Applying the Six Sigma (DAMAC) model needs to have black belt expert, which requires more cost, time, resources and knowledge.”*

Participant 2 in FGS (3) indicated that *“there is no system supporting the technical maintenance reporting, and consequently it would be hard to implement it, as the data required for analysis would be difficult to collect”*. One of the common barriers affecting the maintenance environment explained by Participant 4 in FGS (1) *“is the registration of job orders, and without proper registration it would be impossible to measure performance.”* Hence Six Sigma was believed to be inappropriate to the BM environment.” Participant 2 in FGS (3) indicated that *“There is a lack of six sigma training available for staff within the department and there is a shortage of qualified local contractors.”*

In the Saudi BM industry, the problem of a shortage of expertise was evident, as indicated by Participant 4 in FGS (2) who referred to this limitation, saying *“we do not have people who are aware of problem solving principles in the operation and maintenance department,”* while Participant 5 in FGS (1) stressed the need in this respect, when he said: *“A person who has experience in Six Sigma as a master black belt is really needed,*

as he can provide valuable understanding to the BM department". Hence, it can be seen that the practitioners believe in the critical role played by experts in identifying, defining, and solving problems using IT methods.

Training is a crucial factor in the successful implementation of Six Sigma projects. It is critical to provide the opportunity to staff to improve their comfort level through training courses (Hendricks and Kelbaugh, 1998). Education and training enable people to better understand the fundamentals, tools, and techniques of Six Sigma. Training is essential to the communication of information to make sure that managers and employees apply the complex Six Sigma techniques effectively; the identification of expertise possessed by employees is inherent in the belt system (Hoerl, 2001). Training is part of the communication process to make sure that managers and employees apply and implement the Six Sigma techniques effectively (Kwak and Anbari, 2006). The results confirm studies by several researchers (Hendrickes and Kelbaugh, 1998; Hahn et al., 2000; Hoerl, 2001; Ingle and Roe, 2001) on the subject, when they say that due to the risks that an unsuccessful choice can represent, selecting candidates for Six Sigma specialisation (Master Black Belt, Black Belt or Green Belt) should be done carefully.

Summary

Successful implementation of any methodology in an organization requires commitment from top management and employees. Top management becomes the champion for the methodology committing necessary resources needed to institutionalize the methodology. Employees, on their part, make sure that they study, use and appreciate the methodology to ensure successful implementation. The lack of training and expertise in Six Sigma, since Six Sigma is still relatively new in BM industry in SA. This particular QMC was seen by the participants to require Six Sigma experts because of the lack of awareness about this approach, methodology and implementation. Outstanding among the principal factors to guarantee the effectiveness of Six Sigma, are management's commitment to the programme, in virtue of the need to allocate resources (Goh and Xie, 2004), the existence of organisational infrastructure adequate to assure the introduction, development and continuity of the programme (Wiper and Harrison, 2000), the selection and training of the professionals involved with Six Sigma (Hoerl, 1998) and the selection of projects (McAdam and Lafferty, 2004).

Henderson & Evans (2000) also suggest upper management involvement, organizational infrastructure, training and statistical tools as the major components for a successful Six Sigma implementation (Henderson & Evans, 2000). Not surprisingly, all the participants expressed the opinion that Six Sigma would not be an effective QMC because of the enormous shortage of IT tools and black belt experts.

QMC 3: Lean Management

The third QMC, Lean Management, was then introduced to the focus groups by the researcher, and again the majority of members agreed that this was a new concept for them, but nonetheless observed that, in practice, this methodology and approach are already implemented via a weekly BM department meeting.

Theme 1: Theory of Lean Management

Lean Management is defined as meeting client requirements while minimizing waste. The themes that emerged from these criteria are detailed below.

Criterion 1: Comprehensiveness

The participants believed that the Lean Management concept would be possible to implement through some initiatives for quick improvement. In respect to implementing Lean Management, Participant 2 in FGS (2) indicated that *“However, whilst it may be applied through these meetings to improve some processes and activities within the BM department, as a methodology, Lean Management is not adopted.”* Participant 2 in FGS (2) pointed out that *“for this to happen it is necessary for experts to reduce the non-value adding process and also limit the wastage of money when taking action to replace machines, as a positive effects”*.

Many participants share the same feeling, such as Participant 2 in FGS (3) emphasised that *“it could be applied to help management in eliminating a large problem but that although it might be easy to do this, senior management have to be interested in it”*.

Criteria 2: Awareness and Understanding

The participants believed that the Lean approach was easy to understand and apply. Participant 3 in FGS (1) commented that *“this concept is already implemented in regular meetings as a means of improving the internal processes related to contractors, and to reduce the administration process and maintenance problems.”* It was also pointed out by

Participant 4 in FGS (2) that “*Lean Management in the engineering sense must be implemented on a daily basis.*”

Theme 2: Implementation of Lean Management

The focus of Lean Management is manifested in an emphasis on flow, based on the five essential steps in Lean Management discussed in Chapter 3.

Criterion 1: Need for Human Resources

The human attitude factor is one of the main aspects that retard the application of Lean Management in the BM industry in SA. Attitude, as discussed by several participants, refers to the tendencies regarding intent, commitment and co-operation that need to be present within the parties if they are to successfully implement the lean concept. If these parties are incapable of co-operating among themselves, the implementation of lean construction will definitely be negatively affected, as it needs commitment and a strong co-operative network amongst all concerned parties.

Criterion 2: BM Infrastructure

In BM projects, many participants have to work together especially clients and contractors. Therefore, there is a need to establish and improve communication between all parties. In the process of implementing the lean concept, weak communication between respective parties will lead to the disruption and ineffectiveness of the co-ordination system. This situation will then result in the concerned parties failing to fully realize their responsibilities, which, in turn, will cause the implementation of the lean concept to be unable to achieve its maximum potential. There was no more debate about this criteria for Lean Management.

Chase (1999, p. 3), points out that “*it is a long-term plan for actually implementing a lean concept*”, and that whilst benefits are evident, the organization needs to view lean as a long term strategy. Sheridan (2000, p. 6), proposes that it takes: “*three years to become competent in applying such tools as set-up reduction, standard work or cell building and five years to instil a firm belief in all the tools*”.

Criterion 3: Need for Commitment and Funding

The top management of BM department has a major role to play in achieving a successful strategic plans. From the discussion, the researcher found that many BM projects face the

problem of lack of support from the top management in implementing the lean concept. Without the support of the top management, the professionals involved in the BM sector may face numerous difficulties in adapting the lean concept.

On the other hand, even though a commitment by upper management may be observed both in terms of participating in the improvement program as well as creating conditions for their subordinates to participate in it, the existence of a person that leads the improvements project may not be clearly perceived. The success of lean practice lies in top management commitment in developing and implementing an effective plan and adequately providing the required resources and support to manage changes arising from the implementation.

Although many variables may affect the success of a lean manufacturing implementation, many researchers agree anecdotally that commitment by top management is vital (Alavi, 2003; Bamber and Dale, 2000; Boyer and Sovilla, 2003; Parks, 2002; Womack and Jones, 1996). Top management should not only demonstrate commitment and leadership, it must also work to create interest in the implementation and communicate the change to everyone within the organization (Boyer and Sovilla, 2003). Management must be visibly connected to the project and participate in the lean manufacturing events (Alavi, 2003; Boyer and Sovilla, 2003; Emiliani, 2001). A lack of investment by upper management in the lean implementation may also affect the success of the implementation in less visible ways.

Theme 4: Need for Training and Experts

It is believed from the focus group discussion that training is an undisputed agent of change for implementing improvements inside an organization and that training workshops generate a greater participation and commitment towards such processes. Finally, it is concluded by the participants that the main elements to be transmitted in a training session must be motivation to the process and the company's commitment to it. Parties involved in a BM project need to be given training to enable them to acquire the required knowledge and skills in implementing the concept. The training to be given has to be balanced in terms of understanding the concept and principles of lean as well as comprehending the required tools to undertake the concept. According to Kim and Park (2006), one hurdle that disrupts the success of lean approaches is the fact that training is

only centred on the lean tools that can improve productivity and performance, but with minimal focus on the lean concepts and principles.

Summary

The implementation of Lean Management in SA is still relatively new and the understanding of this concept, as well as its method of implementation, is quite limited even among the professionals involved. Lean Management, it was claimed, is in fact already implemented but on a random, ad hoc basis, resulting from individual efforts and certainly with no planning. Group members stated that it was easy to apply but had no effect upon the quality of work. Karlson and Ahlstrom (1996, p. 7) maintain that “*the important point to note, however, is that lean should be seen as a direction, rather than as a state to be reached after a certain time.*”

However, the barriers identified in several studies seem to be related to management issues. A thorough review of research by (Common et al., (2000), Alarcon et al., (2002), Forbes and Ahmed (2004), Olatunji (2008) and Alinaitwe (2009)) found delay in decision making, lack of top management support and commitment, poor communication, inadequate resources, and lack of client and supplier involvement,. Though some of these issues appear easy to address, overcoming these barriers is very critical to the implementation of Lean across BM departments.

QMC 4: Lean Six Sigma

The integration between Six Sigma and Lean Management was discussed.

Theme 1: Theory of Lean Six Sigma

The phrase “Lean Six Sigma” is used to describe the integration of Lean and Six Sigma philosophies. The integration of Lean and Six Sigma aims to target every type of opportunity for improvement within an organisation. The theory and approach was discussed in the previous categories 2 and 3.

Theme 2: Implementation of Lean Six Sigma

It can be said that the majority agreed that, in practice, the Lean Six Sigma initiative has not been realised. To create a common improvement methodology you must create an integrated system for managing projects rather than separate systems for Lean or Six Sigma projects. For an organization to adopt Lean Six Sigma requires quality

improvement processes obtained by integrating Lean principles with Six Sigma methodology

In fact the group members expressed the view that the implementation of Lean Six Sigma would deliver an excellent environment, but that it would be difficult to handle two QM concepts at the same time without outsourced technical support. Nonetheless, they did agree that to start such implementation on a step-by-step basis would help to improve the performance of the BM process.

For a BM department it is not easy to adopt QMC without the assistance of a consultant to help set up the programme of activities. It was agreed that neither Six Sigma, nor Lean Six Sigma were suitable candidates for implementation in SA BM departments.

QMC 5: ISO 9001 Standard

The last QMC introduced during the focus group sessions was the ISO 9001 standard. The approach for implementing this was introduced by the QM consultant from a practical point of view and some of the members showed some awareness of this concept, because it is more popular than the others.

Theme 1: Theory and Approach of ISO 9001 standard

ISO 9001 sets standards for systems and paperwork by providing organisations with guidelines on how to establish systems for managing quality systems. The majority of participants in the four focus group sessions were more positive towards the ISO 9001 approach, as discussed in the following accounts of the emergent themes.

Criterion 1: Comprehensiveness

It was also suggested by Participant 4 in FGS (1) that *“if ISO 9001 provided standards and templates to follow, this would be the most useful quality strategy to adopt since definite instruction was what was required.”* Further, Participant 1 in FGS (2) argued that *“it will be suitable for establishing BM maintenance documentation and templates.”* Participant 4 in FGS (2) felt that *“this method would assist to improve the BM process inside our departments and allow us to introduce important issues.”* “Standards ” in the ISO Methodology are not limited to standards developed and published by ISO, but comprise all consensus-based standards issued by any standards-developing organization.

Criterion 2: Awareness and Understanding

It was believed that the ISO 9001 standard was easier to understand than other QMCs in term of approach, methodology and implementation and could lead to an improvement in BM departments.

Theme 2: Implementation of ISO 9001 standards

The fundamental point in the ISO methodology is to consider the company perspective: its environment, objectives, business processes and activities. The implementation of ISO 9001 QMS can be divided into five stages; planning (plan), documentations (do), verification and validation (check), deployment (act) and continuous improvement. The following are the two criteria that support the effectiveness of ISO 9001 in BM industry in SA.

Criterion 1: Need for Human Resources

Many participants stressed that “*the necessity of employee involvement for successful ISO 9000 registration and maintenance.*” Similarly, Participant 2 in FGS (3) affirm that “*the key to success of ISO 9000 registration is the unflagging involvement of everyone in the BM department.*” The involvement will be effective when employees are organized into teams. Team members, leaders, and facilitators will understand the factors that contribute to success and will recognize the natural evolution of teams through four basic stages: forming, storming, norming and performing.

Criterion 2: BM Infrastructure

The absence of such guidance was considered to have led to major problems that have caused delays and wasted money in the public sector BM industry in SA, as discussed in Chapter Five. The BM process has been operated on an informal basis and without any standard practice or procedures for guidance. It was agreed by Participant 4 in FGS (1) that “*through this provision of a standardised system, the ISO 9001 could solve problems because guidance would be in place to help clients to follow up and monitor contractors’ duties.*” Moreover, Participant 5 in FGS (2) considered that “*the ISO 9001 standard is easier to implement than the others as it represents a guideline from which to build a QM system.*”

In the discussion concerning ISO 9001, Participant 5 in FGD (1) stated that “*the ISO 9000 is eminently suited to the requirements of public BM departments, as it allows them to*

apply specified standards to bring improvements to their processes. It becomes operationally more efficient". At the end of the focus group session, all members agreed that the ISO 9001 standard represented the best option in the current situation. Even the member who preferred the Six Sigma approach admitted that ISO 9001 was more realistic. Hence, this concept was considered by the directors of BM departments to be the most appropriate means of improving the BM process. Participant 3 in FGD (3) mentioned this as being *"the easiest and most suitable and effective QM approach for implementation in a BM department, currently"*.

Chow-Chua et al. (2003) point out such barriers to implementation as the lack of training of seasonal personnel, inadequate resources (financial and human), lack of infrastructure, a failure to gain workforce commitment to QMS implementation, and a lack of ISO 9001:2000 experience and knowledge.

Criterion 3: Need for Commitment and Funding

A situation which practitioners expressed great concern about was the absence of communication links during BM processes. It was said by Participant 3 in FGS (2) that *"it is hard to control the contractor's duties because of the lack of communication, so I think this guideline would improve this issue."* In this first focus group, Participants 3 and 4 suggested that *"the ISO 9001 should be embarked upon as a first step, and it would help to work towards the TQM (bottom-up approach)"*. Participants 3 and 5 in FGD (2) agreed *"we need to standardise our process and develop effective forms to improve the performance and to overcome the current problems,"* and this was a sentiments shared by all members. Moreover, Participant 2 in FGD (4) claimed that *"it would be beneficial to have a quality management system to set out clear instructions and templates for engineers and technicians."* Participant 5 in FGD (1) argued that *"from experience, the main effect as a standard tool was that it is useful in improving BM processes and in distributing duties clearly."* Another group member, Participant 6 in FGD (2), however, said that *"a contractor who was not qualified and had no experience in ISO 9001 would struggle to apply this QM concept,"*

The critical factors for the successful implementation of the ISO 9001:1994 standard were identified by Augustyn and Pheby (2000) as the commitment and support of senior management.

Criterion 4: Need for Training and Experts

In addition, Participant 1 in FGS (3) believed *“it would help to begin with the ISO as a baseline, and other QM concepts could be introduced and integrated with it”*. Another Participant (3) in FGS (1) gave the opinion that *“the ISO 9001 methodology gives a roadmap by which the BM department could to achieve step-by-step improvement.”* This participant also said: *“We need organized forms that help all maintenance members to provide clear duties and responsibility.”*

Thus, the participants agreed the adoption of ISO 9001 standards will assist all BM clients in their efforts to manage BM activities in the proper way. However, Participant 1 in FGS (4) notes that: *“There is no ISO 9001 standard applied in public BM departments in SA; if a BM department adopts a standard, it will use what is appropriate for it only”*. Maintenance managers will be able to follow an ISO 9001 standard methodology that is sufficiently detailed to provide a routine that can help overcome the poor BM management practices.

Augustyn and Pheby (2000) note the importance of the positive attitude of employees towards ISO 9001:1994, employee training and commitment to quality, and the presentation of the ISO 9001:1994 elements to employees in a clear manner; these factors correspond to the latent construct of “employee attributes” in the present study.

Summary

A debate among members took place regarding the suitability of ISO 9001. Most strongly agreed that the ISO 9001 was the best method to use as a means of developing a quality culture within BM departments, as it provided forms, with firm instructions on how to perform. ISO 9001 sets standards for systems and paperwork (but not products) by providing organisations with guidelines on how to establish systems for managing quality products and systems (Barnes, 1998; Bryden, 2004).

In particular, a lack of management and leadership has been identified in the literature as an important barrier to the success of the implementation of ISO 9001:2000 (Singh et al., 2006). In a similar vein, Bhuiyan and Alam (2005) identified lack of management support and lack of training as important barriers to successful implementation of ISO 9001, together with resource constraints, and employee resistance to change. Magd (2008)

identified important barriers to the effective implementation of ISO 9001:2000 as being inadequate senior management commitment, a lack of qualified personnel, insufficient training with respect to quality issues, a lack of financial resources, and a failure to define responsibility and authority for personnel. In a similar vein, Cheng et al. (2007) also identified a lack of senior-management commitment, employee resistance to change, and inadequate training and support as barriers to the successful implementation of ISO 9001:2000.

The ISO 9001 has now become the QMS model recommended by the followers of the quality movement as a benchmark for implementation of good management and process control in a variety of industries and sectors (McCornac 2006; Tricker 2008; Wahid, Corner and Tan, 2011).

6.4 Conclusion

This chapter has discussed the outcomes of four focus group sessions, which assisted in determining the most suitable and effective QMC for BM in public organisations in Saudi Arabia. Nineteen practitioners, and two QM consultants participated in the FGS. The findings presented in this chapter validated the general BM process diagram developed by the researcher. The five QMCs were discussed within the four focus groups in terms of their principles, tools, methodology, and approaches, in order to identify the most suitable one for BM in SA; each QMC has a different way in which the improvement process should be handled.

The main issues which need to be closely considered to apply any quality management system successfully have been identified. These issues are full awareness of the quality management concepts, paying more attention to the contract's terms and improving the communication and co-operation among BM stakeholders, and providing workshops and training courses to fully understand how QMCs work. There is limited research related to the application of QMC in BM and an absence of any QM standard process for use in the public sector BM industry.

The study has identified two themes: Approach and Methodology to compare the five QMCs; subsequent to the identification of these themes, the following criteria emerged as separate areas for concern:

Comprehensiveness, Awareness and Understanding, Need for Human Resources, Strong BM infrastructure, Need for commitment and funding, Need for training and experts and IT Need.

It has also been shown that the point of saturation had been reached with the fourth focus group session and that no further discussions were necessary. A comprehensive debate had concluded that the ISO 9001 standard was the most suitable and effective approach to use as an initial move to improve the BM process in SA.

In the following chapter, a developed quality management system is presented based on the ISO 9001 standard.

Chapter 7: Development of a Quality Management System

7.1 Introduction

Based on the findings revealed from the previous stages of this research, it was noted that there is a clear absence of an effective Quality Management System (QMS) in the existing building maintenance industry. In addition to that, four focus group sessions were conducted to find out the most suitable QMC for the current status of the BM industry in SA. As result, ISO 9001 standard was decided to be the one to be adopted. Hence, this research makes an attempt to fill this gap in building maintenance industry research by developing a QMS based on the ISO 9001 standard.

The aim of this chapter is to prepare all the required QMS documentation through the development of a manual and procedures of ISO9001 standard, in order to independently implement and follow the QMS documentation for better management of the public building maintenance industry in Saudi Arabia. The steps for developing the QMS are as follows:

- Set up a QMS based on the ISO 9001 standard.
- Link the developed BM process diagram with the proposed QMS.
- Validate the QMS by conducting Focus Group Sessions with experts.

This chapter will discuss the first two steps while the third will be discussed in the following chapter. The next section illustrates the reasons behind developing the QMS.

7.2 Strengths and Weaknesses of the Current Practice

As revealed in the exploratory interviews in Chapter 4, the quality management system is relatively new in the Saudi BM industry, where there is a lack of knowledge and awareness of quality management concepts. Furthermore, the need for a QMS and interaction during the BM process, in order to manage the process effectively, is not clearly understood by the public sector participants. Therefore, the strengths and weaknesses of these current practices must be taken into consideration before developing a proposed QMS for BM management. This part of the study will enable the researcher to better understand the needs of the quality management system to be applicable for the

Saudi public BM industry. Based on the analysis of the exploratory interviews, the strengths and weaknesses in the current practice were identified as follows:

Strengths:

To improve the current practice some points were considered as strengths,

- There is agreement on the need for a quality management system for the following reasons:
 - To assist in better BM management
 - To help in solving common BM problems
- public sector clients recommended developing a quality management system

Weaknesses:

- Poor co-ordination and communication among the BM stakeholders in terms of:
 - Progress meetings
 - Relations between client and contractor
 - Procedures taking a long time
 - Bureaucracy among the parties.
- Shortage of team members, such as;
 - Lack experienced and qualified engineers.
 - Lack of training courses in quality management.
- Not enough attention to application of quality management concepts, for example;
 - Lack of awareness of quality management concepts
 - Lack of understanding the process of BM management
 - Assuming a quality management system is complicated and costly.
- Poor engagement of BM stakeholders:
 - Lack of interaction between the client and contractor during the BM process
 - Stakeholders' responsibilities are not well identified in the BM process

7.3 Quality Management System

The implementation of an effective **quality management system** (QMS) offers a clearly structured and systematic approach to improve the customer experience, so helping to meet the BM department's aims and objectives and successfully implement management for the delivery its services.

A QMS can be defined as: “A *set of co-ordinated activities to direct and control an organisation in order to continually improve the effectiveness and efficiency of its performance*” (Hooper, 2002). These activities interact and are affected by being in the system. The main thrust of a QMS is in defining the processes which will result in the improvement of quality services rather than in detecting defective services after they have been performed. The researcher has already developed the BM process flow diagram and the interaction between the stakeholders. The quality management system consists of managing structure, responsibilities, procedures, processes, and management resources to implement the principles needed to achieve the quality objectives of an organisation. A good QMS does not in itself make an organisation more profitable, efficient or customer focused, but it will give an organisation the ability to manage better.

ISO 9001 Standards have been identified by this research as the most suitable QMC to be applied in BM in SA. Therefore, it will be the basis of the principles to develop the proposed QMS. As defined in ISO 9000:2005, a QMS is a management system that directs and controls an organization with regard to quality. Consequently, with the up-to-date knowledge of the current BM process and the level of attention paid to quality initiatives in BM departments in the Saudi public sector (as gathered from the interviews reported in Chapter Five), the researcher was able to develop the quality management system which is the ultimate objective of this research.

This chapter discusses the development of a quality management system particularly for public BM departments, such that they can implement an effective QM system based on *ISO 9001:2008, Quality management systems – Requirements*. All requirements of this International Standard are generic. Therefore, they will be customised to support the work of the BM departments. From the comprehensive understanding of the existing BM process in Saudi public organisations (obtained from the interview exercise), and the requirements expressed by the practitioners (as voiced in the four focus group sessions), the researcher was able to focus the quality management system on the generic BM process and develop standard forms for the improvement of that BM process, in order to find solutions to the various problems facing the process, as highlighted in Chapter Five.

The following sections describe the ISO 9001 methodology, then proceed to explain how the quality management system will be used.

7.4 ISO 9001 Standard Methodology

The ISO 9001 standard relates to the individual procedures involved in any larger process, and includes all the inputs from the first step to its delivery. None of these procedures can be managed without the involvement and understanding of the people who hold responsibility for their ultimate delivery. As noted from Chapter Three, the ISO 9001 standard should achieve the following goals: improvement of the definition and standardisation of the work procedures, improvement in the definition of the responsibilities and obligations of the workers, better involvement in work, and improvement in guidelines.

For an organization to function effectively, it has to determine and manage numerous linked activities. An activity or set of activities using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. The application of a system of processes within an organization, together with the identification and interactions of these processes, and their management to produce the desired outcome, can be referred to as the “process approach”. The process approach is one of the eight quality management principles upon which the entire ISO 9000 series of standards is based. This principle says a desired result is achieved more efficiently when activities and related resources are managed as a process. The word "process" is defined in ISO 9000:2000 clause 3.4.1 as *"a set of interrelated or interacting activities that transforms inputs into outputs."* Inputs to a process are generally outputs of other processes. Processes in an organization are generally planned and carried out under controlled conditions, to add value.

The “process approach” is a management strategy. When managers use a “process approach”, it means that they manage and control the processes that make up their organizations, the interactions between these processes, and the inputs and outputs that tie these processes together. It also means that they manage these process interactions as a system. When this approach is applied to quality management, it means that they manage processes and process interactions as a coherent, process-based quality management system.

Given the generic BM process shown in Figure 6.2, in which the main activities of BM departments are indicated, it was possible for the researcher to figure out the opportunities

for ISO 9001 to be adopted as a quality management system to improve the BM process and overcome the obstacles that were discussed in Chapter 5, as shown in Figure 7.1.

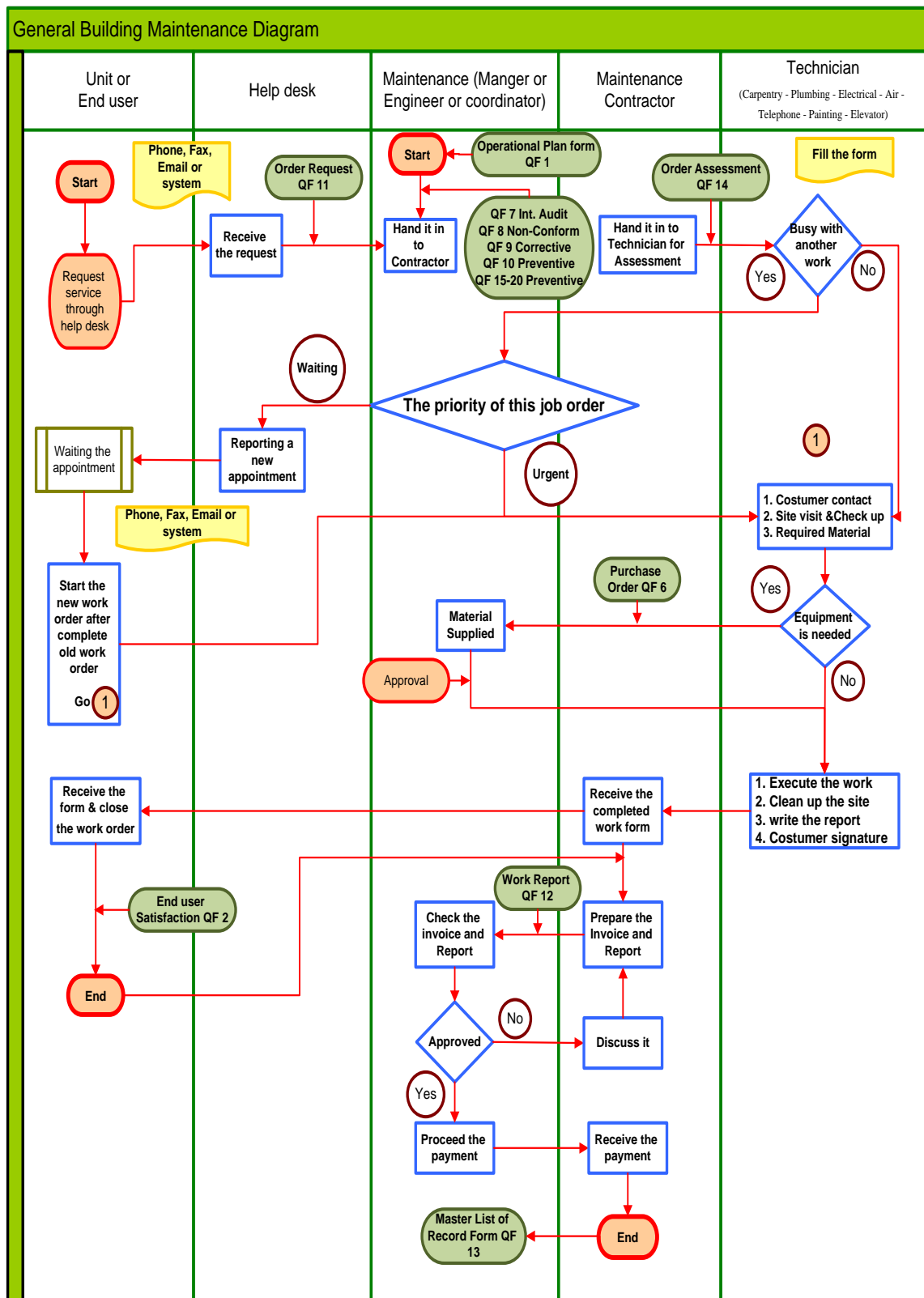


Figure 7.1: The Integrated Generic BM Process

The quality management system is therefore structured according to the BM process diagram identified by the researcher, since this shows each stage clearly and where improvement through the application of the ISO 9001 standard is required and can be achieved. This means that the quality management system will not be a copy of the standard, but rather will be a genuine working document for BM practitioners. The structure of an ISO 9001 QMS Standard (Figure 7.2) based on eight clauses as follows:

0. Introduction
1. Purpose
2. Normative Reference
3. Terms and Definitions
4. Quality Management System
5. Management Responsibility
6. Resource Management
7. Product Realization
8. Measurement, Analysis and Improvement

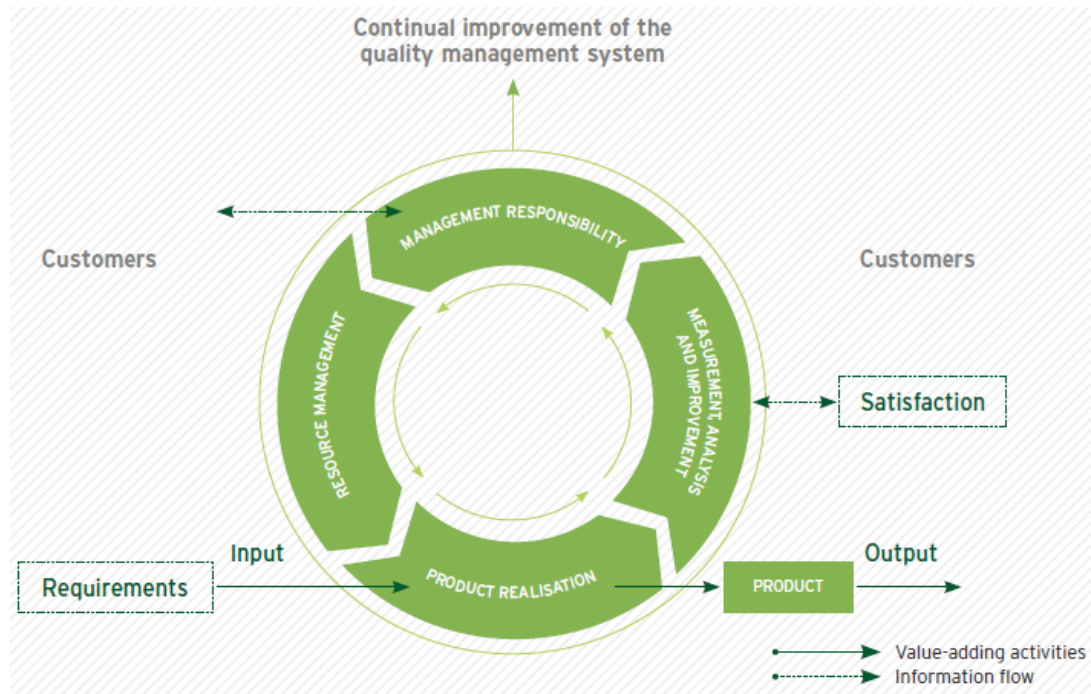


Figure 7.2: Model of a process based quality management system, (ISO 9001:2008)

The first four (0 to 3) clauses do not provide any requirements for a QMS. They just provide background information. The remaining five clauses, numbering 4 to 8 provide the control requirements that a QMS must implement. Each major clause has several sub-clauses. Collectively, these 5 clauses set out the requirements for your QMS. Figure (7.3) gives an overview of the structure of ISO 9001, including the sub-clauses, starting with clause 4, as the concrete requirement section. The structure is usually reflected by the quality manual, which is a mandatory element within a quality management system, which will be discussed in the next sections.

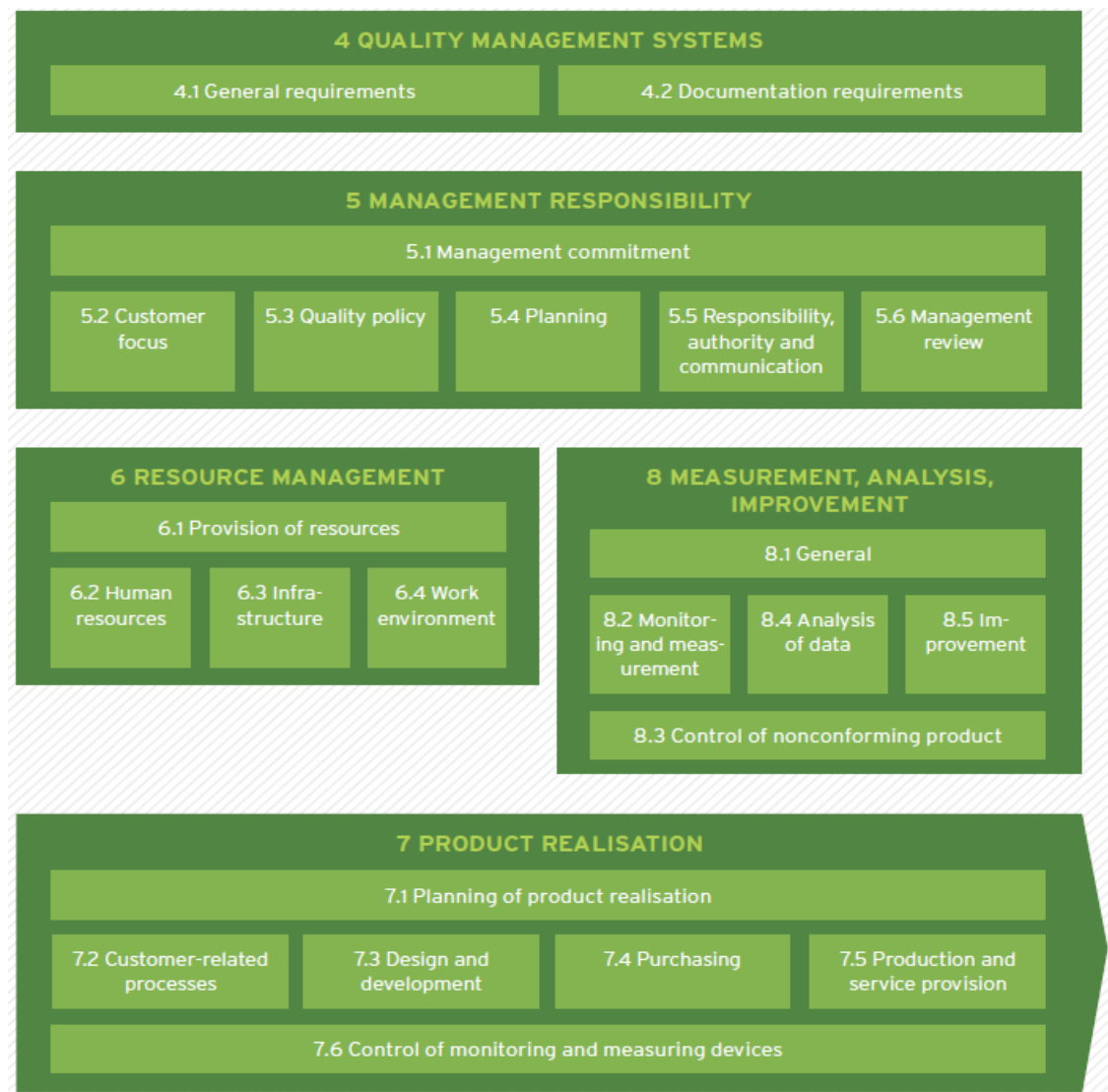


Figure 7.3: The Structure of ISO 9001 (ISO 9001)

ISO 9001:2008 allows an organization flexibility in the way it chooses to document its quality management system (QMS). This enables each individual organization to develop the minimum amount of documentation needed in order to demonstrate the effective

planning, operation and control of its processes and the implementation and continual improvement of the effectiveness of its QMS. The next section will illustrate the development of the QMS.

7.5 The Development of the Quality Management System

Having discussed the steps required to develop a quality management system based on ISO 9001, it is now appropriate to present the proposed quality management system for public sector BM departments. The quality management system satisfies all the requirements of the *ISO 9001:2008, Quality management systems – Requirements Definitions* which includes the ISO 9001 eight clauses which were discussed in the previous section.

0. Introduction

In order to develop a Quality Management System to maintain and continually strive to improve the environment of the BM industry in SA, this system satisfies all the requirements of ISO 9001:2008. The BM processes were identified for the system, and it was then determined how these BM processes interact with the QMS.

As a result of the above investigations, the BM diagram and BM forms have been developed to provide a basic foundation for effective management, process control, audit and continuous improvement

1. Purpose

The purpose of this QMS is to provide the guidance required to ensure and enhance the quality of BM services, as well as developing and implementing a QMS. The purpose of the quality management system is to establish and document the BM procedures that relate to public BM departments and to ensure that all the maintenance documents are integrated in the generic BM process. The documented quality management system is established based on the process approach, as described in ISO 9001:2008 standard. The QMS will help to focus and improve management of the following key functions in BM departments:

- **Corrective and Preventive Works:** implementation of regular maintenance based on the BM process and the BM forms created.
- **Maintenance Works:** From the beginning of the job order to the completion of the process.

2. References

ISO 9001:2008, Quality management systems – Requirements Definitions

3. Term and Definitions

The QMS technical terminology and definitions used throughout this document are those of the International Organization for Standardization (ISO) and in particular, those identified in ISO 9000:2005 Quality management systems - Fundamentals and Vocabulary and related to BM industry.

Quality Management System (QMS):	→ Is the organizational structure, procedures, processes and resources needed to develop and successfully implement management for the delivery of its services
Manual	→ A technically orientated publication intended to provide assistance to people using a particular system or process. It is usually written by an individual with a strong technical background in the area being addressed. Following a manual is not mandatory but users are encouraged to follow them.
End User	→ the employee is in the office and working in the public organisation
General Maintenance:	→ includes (Electrical - Plumbing - Carpentry - Paint - phone)
Preventive Maintenance:	→ Scheduled maintenance (planned maintenance)
Corrective Maintenance:	→ maintenance carried out after a failure has occurred
Maintenance Contractor:	→ the outsourcing specialist for maintenance duties
Technician	→ the worker with a speciality to carry out the maintenance
Maintenance Forms:	→ Documents used to enter data or information generated as a result of certain activities
Maintenance Manager:	→ The person with responsibility for planning, maintenance, implementation and keeping records of documents

4. Quality Management System

ISO 9001:2008 clause 4.1 General requirements requires an organization to “*establish, document, implement, and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard.*” This section describes the structure of the quality management system to identify, plan, document, operate and control QMS processes and to continually improve

QMS effectiveness. The documents and approaches described in this section are based on *ISO 9001:2008, Quality management systems – Requirements*. In ISO 9001:2008, element 4.2.2 describes a quality management system as a document containing a typical four-level quality management system, as shown in Figure 7.4.

Level 1 – Quality Manual

Level 2 – Quality Management procedures

Level 3 – Job descriptions and work instructions

Level 4 – Records and Forms

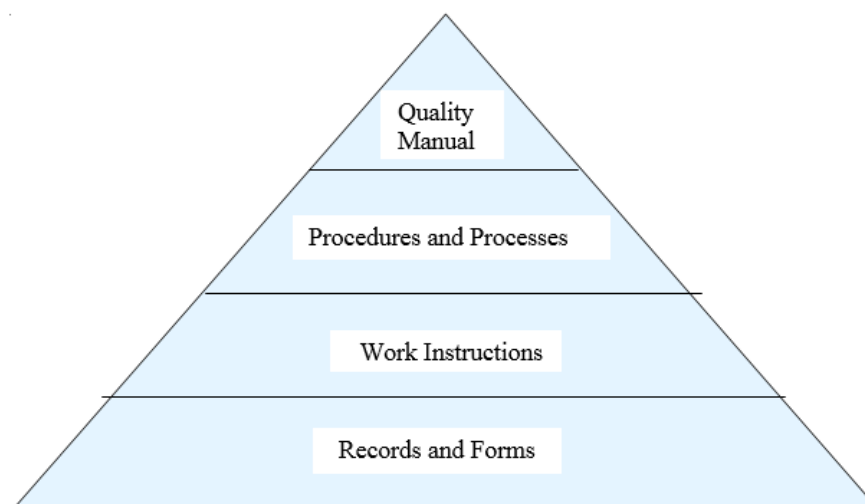


Figure 7.4: Structure of the Quality Management System Documentation

All the documents that are part of the QMS have to be controlled in accordance with clause 4.2.3 of ISO 9001:2008, or, for the particular case of records, according to clause 4.2.4.

Based on the requirements of the practitioners who participated in the four focus group sessions, the researcher focused on Levels 1, 2 and 4 which are concerned with standards and documentation. The following sections illustrate how these four levels are adapted for the proposed QMS.

Level 1 - Quality Manual

Clause 4.2.2 of ISO 9001:2008 specifies the minimum content for a quality manual. The format and structure of the manual is a decision for each organization, and will depend on the organization's size, culture and complexity. The quality manual gives an

organizational profile; presents the organizational relationships and responsibilities of persons whose work affects quality and outlines the main procedures. It may also describe the organization's quality policy and quality objectives.

The manual has been written to define and support public maintenance work departments. The quality manual outlines the format of documents used in the QMS as well as the roles and responsibilities of the personnel responsible for management of the QMS and for management of the technical procedures. The quality manual also documents the administrative, organizational and maintenance work necessary for its proper management. It is the responsibility of top management of public BM departments to be fully conversant with the contents of this quality manual (particularly regarding those sections which relate directly to their specific jobs) and to ensure follow these guidelines.

In developing a quality manual it helps to look from the perspective of a new employee who would use the manual as an induction tool. It should provide them with a clear picture of how the BM operates and the processes associated with achieving its outcomes. The quality manual can also contain additional information about the BM department, such as policy, information about customer service, future strategies, departmental structures and charts, as required. It is important that this document is easy to read and understand and reflects the values that you wish to convey to the reader.

Level 2 - The Quality Management Procedures

The Quality Management Procedures (QMPs) describe the BM processes and their interfaces in detail, as discussed in Chapter 5. A process is a set of inter-related or interacting activities which transforms inputs into outputs. A key stage of developing an effective QMS is to identify and describe significant processes associated with a BM department's function. The top management has to follow the developed process diagram which identifies the inputs, sequences of activities and outputs for the building maintenance processes for the effective implementation of the quality management system. The documentation of procedures is mandatory to comply with ISO 9001:2008 requirements. Documents are needed by the top management to ensure the effective planning, operation and control of its processes.

The developed generic BM process for the general maintenance map (see Figure 7.5) are both essential to start implementing ISO 9001 OMS. Further, the analysis of the processes is the driving force for defining the number of forms and amount of documentation needed for the quality management system, taking into account the requirements of ISO 9001:2008. It should not be the documentation that drives the processes. Therefore, several BM forms have been customised and developed to be integrated in the BM process diagram to demonstrate the achievement of the required quality and the effective operation of the maintenance departments. These developed forms will be discussed in the description of level four of this QMS.

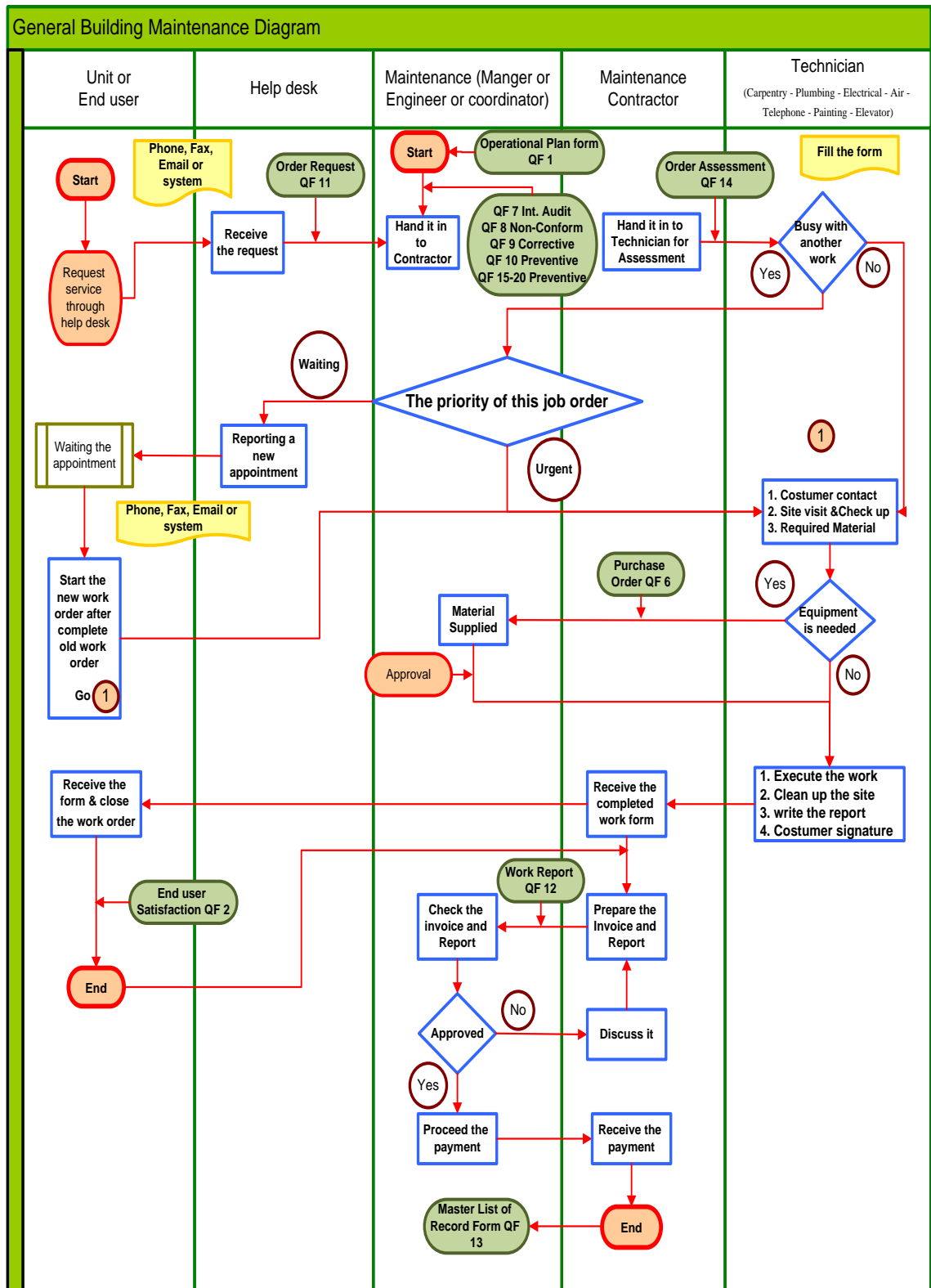


Figure 7.5: The Integrated Generic BM Process

Level 3 - Job Descriptions and Work instructions

Establishing job descriptions is essential to determine competence level for each assigned job. These documents are used at the time of recruitment, execution of duties and performance appraisals, change of status, promotions and above all during training in the needs identification process.

Work instructions are required at the working level for all the technicians and administrative/finance staff. An individual may be assigned to more than one job and the work instructions are written for each of the assigned jobs. This study excludes this level from the development of QMS because it is Human Resource (HR) department issue and would involve connecting with HR departments for more exploration.

Level 4 – Forms and records

Organizations are free to develop other records that may be needed to demonstrate conformity of their processes, products and quality management system. Analysis of the processes should be the driving force for defining the amount of documentation needed for the quality management system, taking into account the requirements of ISO 9001:2008. Therefore, the researcher developed sufficient forms and records based on the need from the current BM process and the investigation conducted during this study. The main aim of these forms and records is to demonstrate the achievement of the required quality and the effective operation of the maintenance departments through solving the current common problems related to BM activities and improving the stakeholder's performance.

The Maintenance Manager has overall responsibility for ensuring that all QMS documents, including forms used to create quality records, are controlled as per document control procedure. All documents which are defined as quality records are also controlled. All records are developed to provide evidence of conformity to requirements and of the effective operation of the Quality Management System in the BM environment.

All developed forms and records should be legible, dated, complete, and signed by authorized personnel. The records should be maintained in such a manner as to ensure that they are secure and easily retrievable for inspection. A master list of all quality records should be maintained, detailing the record type. Examples of forms and records that should be made available to the stakeholders at any time are:

	Quality Form No#	Forms Title	ISO 9001 Clause
1	QF 9	Corrective Action Request	Product Realization
2	QF 10	Preventive Action Request	
3	QF 11	Record of Maintenance Requests	
4	QF 12	Preventive or Corrective Maintenance Report	
5	QF 15-20	Weekly Preventive form for items such as Electricity, Generators, Chillers, Air Unit, Elevators and Pumps	
6	QF 13	Master List of Record Forms	Measurement, Analysis and Improvement
7	QF 14	Master List of Corrective or Preventive Request Forms	
8	QF 7	Internal Audit Report	
9	QF 8	Non-conformity Report	
10	QF 2	Employee Satisfaction Survey Form	
11	QF 1	Operational Plan Form	Management Responsibility
12	QF 3	Management Review Report	
13	QF 4	Minutes of the Meeting Form	
14	QF 5	Meeting Agenda Form	
15	QF 6	Purchasing Order Form	Resource Management

Table 7.1: The forms and Records linked to ISO 9001 Clauses

These forms and records are developed based on the needs identified in the BM process diagram to solve the related common problems and improve the process flow between the stakeholders. After that, the forms were integrated in the BM process diagram as shown in Figure 7.5. These forms will then be related to the ISO 9001 model of a process based quality management system. The objectives of Four ISO clauses (5 to 8) will be achieved through the implementation of the forms shown in Table 7.1. These developed forms and records are available in Appendix C. In addition, these forms will be discussed further in the sections dealing with the next four ISO clauses (5 to 8).

5. Management Responsibility

Clause 5.1 requires top management to demonstrate its commitment to development and implementation of a QMS. This demonstration of commitment should also involve a formal endorsement that is communicated to all staff. The appointment of a quality manager is a key factor in the success of a QMS. The holder of the position will inevitably be the driving force behind the QMS and the primary focus for issues pertaining to the QMS

The director of operations and maintenance should appoint QA/QC Manager as Quality Management Representative (QMR), with delegated responsibilities for ensuring that an ISO 9001:2008 compliant QMS is implemented, and maintained, for promoting awareness of customer requirements throughout the organization and for ensuring that the performance of the QMS is reviewed by Top Management for effectiveness, continuing suitability and the need for improvement. It is imperative that the QA/QC Manager clearly establishes that the finances to support a QM initiative will be available. The proposed development and implementation of the QMS should be formally documented and should include the proposed implementation strategies, a broad timeline and estimated budget. In addition, introductory training should be provided for all staff involved in the QMS, starting with the core QM team and especially the CEO/Director. A basic introductory ISO training course helps to ensure the successful implementation of a QMS by providing a sound understanding of the principles and practices pertaining to ISO 9001.

The full understanding of all the employees depends on their responsibilities, and that is determined by identifying those responsibilities in the operation and maintenance departments through job descriptions and documented work procedures. The operation and maintenance director ensures that all staff members are made aware of the importance of their own activities and how their contribution can help achieve the quality objectives.

The four forms developed for this ISO clause in Table 7.1 above are intended to help the top management to set the operation plan for their departments and to follow up the weekly actions for more enhancement and improvement. Operational plans include plans for project management, quality management, human resources, communications and risk management.

The Maintenance Director sets direction and ensures the success of the strategy through the clear definition and communication of QMS responsibilities and authority.

- **Top Management** – Members of Top Management including Director and Divisional Heads control the systems and processes by which work is accomplished. Top Management is responsible for planning, development and communication of the quality policy, QMS Planning, and the provision of resources needed to implement and improve the QMS and management reviews.
- **Management** – All managers and engineers are responsible for execution of the Quality Plan and implementation of the policy, processes and systems described in this manual. All managers are responsible for planning and controlling QMS processes within their area(s) of responsibility, including the establishment and deployment of operational level objectives, and the provision of resources needed to implement and improve these processes. Managers also conduct employee performance reviews. Management with responsibility and authority for corrective action are notified promptly of non-conformities.
- **Employees** - All staff are responsible for the quality of their work and implementation of the policy and procedures applicable to processes they perform. Employees should be motivated and empowered to identify and report any known or potential problems and recommend related solutions through internal audits and/or the continual improvement and corrective/ preventive action processes.

6. Resource Management

The operation and maintenance director and section managers are responsible for providing the necessary resources and qualified human resources to perform the work in order to achieve business requirements, including trained staff and appropriate equipment, facilities, support services and work environment needed to implement, manage and improve an effective QMS process and enhance stakeholder satisfaction.

Top management controls the purchasing process to make sure that products which are purchased conform to the requirements. Top management must ensure the adequacy of specified purchase requirements prior to their communication to the supplier or partner.

For projects which are out-sourced, BM management evaluates and selects suitable suppliers. Suppliers for such purchases are selected on the basis of technical reasons and the lowest bid in each case. The form which needs to be used in this clause is the Purchasing Order Form.

7. Product Realization

The sequence of processes (and sub-processes), which are needed to provide the projects undertaken by BM department, is product realization. Thus product realization refers to all the processes that are used to bring a product or service into being.

The forms to be used in this clause, as illustrated in Table 7.1 are as follows:

- Corrective Action Request
- Preventive Action Request
- Record of Maintenance Requests
- Preventive or Corrective Maintenance Report
- Weekly Preventive form for Electricity, Generators, Chillers, Air Unit, Elevators and Pumps.

8. Measurement Analysis and Improvement

Conducting an audit and developing a robust internal audit schedule is another critical component of QMS. This involves setting requirements to plan, measure, analyze and improve processes that demonstrate product and QMS conformity and continually improve QMS effectiveness.

The overall objective of the QMS must be to enhance customer satisfaction by meeting their requirements. This objective can be achieved by using the ISO 9001 requirements to control your QMS processes and by continually improving QMS effectiveness. Top management in maintenance departments should define, plan and implement such measurements and monitor them as required to ensure the achievement of conformity and improvement of its work to continually improve the effectiveness of the QMS. This includes determination of applicable methodologies and the extent of their use.

The internal quality audit is conducted on the basis of the processes and procedures in maintenance department. Audit findings and conclusions shall be documented and submitted to the Maintenance Manager(s) for consideration. Corrective action will be

taken to resolve all procedural nonconformities; follow up checks or audits shall be carried out to ensure that such corrective action has been carried out and is effective. All audit findings shall be submitted to the Management Review Meeting for review and evaluation. The forms to be used in this clause, as illustrated in Table 7.1 are as follows:

- Master List of Record Forms
- Master List of Corrective or Preventive Request Forms
- Internal Audit Report
- Non-conformity Report
- Employee Satisfaction Survey Form

7.6 Summary

As discussed in Chapter Six, the ISO 9000 is eminently suited to the requirements of public sector organisations. Moreover, from the focus group discussions it was also clear that BM practitioners believed this would be more appropriate than other QMCs in their efforts to improve quality in their departmental processes. Consequently, the quality management system was based on the ISO 9000 since practitioners' commitment to this seemed to have been secured, and through its use, the public sector BM departments would be likely to be able to bring about improvements to their processes and communicate this effort to their stakeholders. It is clear that the standard provides a framework for systematically developing business processes, and lends itself to being promoted through the use of a quality management system designed around the eight clauses indicated in the *ISO 9001:2008, Quality management systems – Requirements*".

Chapter 8: Validation of the Quality Management System

8.1 Introduction

Having presented the developed quality management system as an outcome of the various elements of empirical investigation undertaken during the course of the study, it is now appropriate to consider the validation of the quality management system. The aim of the validation was to test the applicability and clarity of the QMS, to ensure that the developed QMS would add value to the Saudi public building maintenance industry through improving the BM processes and enhancing the management of BM services. Clearly, such validation can only be achieved by the involvement of practitioners (as described in section 4.7.5) to elicit feedback on the proposed quality management system.

In order to achieve the aim of this chapter an interpretive validity assessment was carried out. The technique of the validity assessment was through one focus group session with eight practitioners from representatives of public clients in the Saudi BM industry. Albrecht et al., (1993) suggest that the ideal number of participants per FG session should be between six and eight, to allow the researcher to elicit the responses required. The data revealed was analysed qualitatively through thematic analysis. The following section discusses how the FGS was conducted.

8.2 Focus Group Exercise for QMS Validation

The eight participants in the FGS possessed significant experience and knowledge of BM and QM, and none of them had been involved in any of the previous stages of the study. This strategy was chosen in order to gain different perspectives from different participants, and thereby ensure the rigour of the evaluation process, which was designed to establish whether any modifications to the quality management system are required.

The focus group meeting was conducted in a venue provided by the organiser of the 11th International Operation and Maintenance Conference in the Arab Countries (OMAINTEC), held in Dubai 18-21 May 2014. As a key speaker at that conference the researcher took the opportunity to conduct the focus group session with interested practitioners who had met the researcher at a previous conference in 2013.

Three weeks before the focus group session, the researcher sent the developed quality management system, via email to the practitioners, with the idea that their feedback would be gathered during the focus group session. Details of the eight practitioners were provided in Chapter Four, Section (4.7.5), demonstrating their qualifications, experience and position.

Since none of those present had been involved in the previous steps of the research, the researcher began the focus group session by presenting the research topic to the participants. The presentation took 25 minutes and included details of the background to the research, the aim and objectives of the study, the methodology adopted, data collection, analysis and findings, and the process used to develop the QMS.

The aim of the validation stage was then introduced, in which the value of the developed quality management system, the challenges and obstacles that it could eliminate or overcome, as well as details of its implementation within the Saudi BM industry, were discussed. Thereafter, participants were invited to contribute by giving views and asking questions. The next section will explain the outcomes from the validation of QMS.

8.3 The Result of the Focus Group Session

The main part of the QMS – FGS discussion with the BM practitioners related to questions aimed an examination of how BM departments would be able to apply the effective QMS to comply with ISO 9001 principles and elements. This examination was based on the definition of an effective QMS implementation, which is described as the fulfilment of a department's own specified quality requirements (Kam and Tang, 1997; Al-Nakeeb et al., 1998 and Willar et al., 2010).

The respondents were asked if they felt that a QMS was needed, in order to identify the underlying reasons for adding a QMS to the organization. I also asked the managers if they saw it as applicable, as well as eliciting their expectations of working with a QMS. Based on the discussion, several criteria and two themes emerged from the analysis of the open question. These themes were categorized based on the enablers of and barriers to QMS implementation, as shown in Figure 8.1. The following section will discuss the responses of the focus group participants regarding these themes.

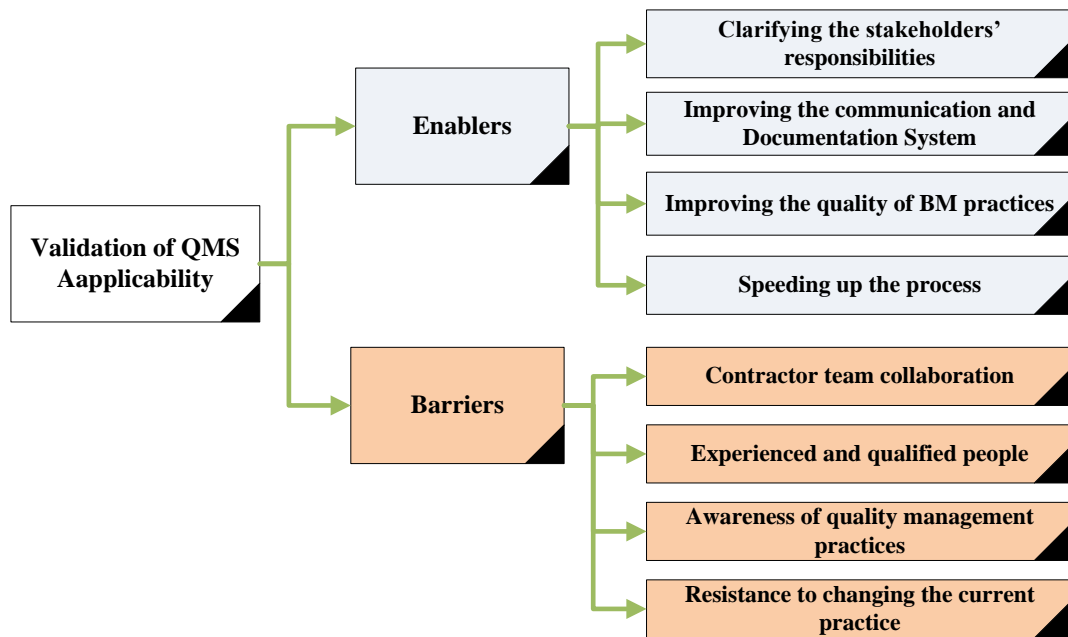


Figure 8.1: Themes in the Focus Group Discussions

8.4 Validation Finding and Discussions

The outcome from the focus group session was very positive. The majority of those presented believed that several factors would affect the implementation of the quality management system. The feedback was provided by participants on the clarity of the QMS that includes eight clauses of ISO 9001, and the items Stakeholders' Responsibilities and Communication Link in the BM process diagram. The analysis of the answers showed that all clauses were considered clear enough to be practised in public BM to provide better management of the BM process in the SA context.

In order for the QMS to be successfully applied, according to the participants, it depends on the willingness of the BM department to look forward to establishing a high quality business. In addition, if the BM department relies on focusing on customer satisfaction, the implementation of the QMS should not be difficult. Another consideration regarding the usefulness of the QMS, was that they acknowledged the QMS as guidance to assist them in properly implementing ISO 9001 in order to improve the quality of BM projects.

The feedback provided by participants on the applicability of QMS included the applicability of the QM process, QMS achievability and the action required to move

towards improvement. The feedback provided strong endorsement that the criteria of this QMS are applicable in public BM practice, as follows:

Participant 1: *“there is an added value from the quality management system, such as the BM process diagram, BM templates and the need to overcome problems.”*

Participant 5: *“I agree it could be used quite widely as a vehicle to implement the ISO 9001 standard within building maintenance activities. Definitely I think it’s one we could use in operation and maintenance projects to quite a high degree.”*

The two themes and criteria are detailed below:

Theme 1: Enablers of the QMS implementation

The four elements called “enablers” are those which will facilitate an organization’s work towards the end-results. The “enablers” are the elements through which an organization can assess its success and managers can determine whether or not they were successful according to their expectations and desires (Sandbrook, 2001, p. 84). The enablers identified by the participants in the focus group include:

- Improving the quality of BM practices
- Clarifying the stakeholders’ responsibilities
- Improving the communication and Documentation System
- Speeding up the process

Criterion 1: Improving the quality of BM practices

Participant 1: *“I think this QMS would improve the level of quality for the BM process.”*

He also, mentioned that *“this QMS would lead to better BM outcomes, as it pays attention to the current BM problems.”*

Participant 2: *“The QMS would improve the workflow of the entire BM process as this QMS identifies the BM process effectively from the early stages.”* Additionally, he expressed the view that that *“This QMS would reduce the current problems of the BM practice because of the good implementation ISO 9001 standards.”*

Participant 3: *“personally, this QMS and its forms will be extremely effective and the clients and contractors will gain better quality from the BM process by knowing their positions in the BM process.”*

Participant 6: *“the clarity of the QMS using QMS forms will assist the stakeholders to get best practice from BM management.”*

From the above comments, it is indicated that the developed QMS can improve the quality of the Saudi public BM projects. Additionally, it can improve the workflow of the BM process to obtain the highest efficiency for better management. When organizations have decided to adopt a quality management system, there are a number of recommendations of what organizations should do. However, there are no specific recommendations for any specific types of organizations, nor regarding their current situations, organizational environment or culture. One of the most important recommendations for organizations is to establish an organizational environment which promotes the development of the QMS according to the requirements of ISO 9001 (Dale et al., 2007).

Criterion 2: Clarifying the stakeholders’ responsibilities

Participant 2: *“it seems that, this QMS identifies the responsibilities of the public client and contractor in the process clearly, which will be reflected positively in the BM management to obtain the best practice.”*

Participant 4: *“the clarity of the stakeholders’ positions during the BM process will greatly assist them to do their tasks without any unexpected interactions which can negatively affect the proper implementation of the BM work order.”*

The above feedback illustrates that, the developed QMS will identify the stakeholders’ responsibilities effectively which will lead to better communications and understanding of the BM practices. Once the relationship between processes is known, the criteria and methods for effective operation and control can be developed and documented. The processes are described in terms that enable their effective communication and a suitable

way of doing this would be to compile the process descriptions into a quality manual that not only references the associated procedures and records but also shows how the processes interact.

Establishing the different responsibilities of a work-force is one of the key elements in the organizational structure and with a QMS come increased responsibilities, often regardless of the employee position (Dale, in Dale et al., 2007, pp. 127-128). When introducing a QMS, the new responsibilities and roles of the employees must be made uniform with the original roles and responsibilities, otherwise there is a risk of employees rejecting the ownership of the new responsibilities (Dale, in Dale et al., 2007, p. 127).

Another important aspect in line with laying out specified responsibilities for employees is the fact that it needs to be documented. One of the fundamental documents for setting up a QMS is the one stipulating the responsibilities and practices for each department, which, of course, also covers the employees in those departments (Dale et al., 2007). Not to be forgotten is the fact that in the framework of ISO 9001:2000 there is an element called “management responsibility” and this covers the required level of management commitment, customer focus and other aspects (Dale et al., 2007). Thus, we cannot solely evaluate the issues with new responsibilities for the employees but also take into account those for the managers. It is important that each manager is aware of what is required of him or her and of the fact that they need to take on more responsibilities than the employees. However, what it seems from FGS is that there is a general concern from management that quality is needed and that striving towards quality improvements is a wish from managers in the BM industry.

Criterion 3: Improving the Communication and Documentation

The ability and ambition to share and document information within an organization can be a good indicator of whether or not it has the capability and motivation to pursue quality and whether or not it will be successful when implementing a QMS. If an organization is good at communication and documentation, it is more likely that it will cope better with the documentation requirements of a QMS.

Participant 4: *“One of the advantages this QMS helps the stakeholders to avoid the unnecessary interactions during the stages of the BM process as their*

tasks are clear enough to manage the BM order which definitely will improve the existing condition.”

Participant 5: *“I strongly believe that, applying this QMS will improve the performance of the BM process by documenting the BM orders.”*

Participant 7: *“I believe that using QMS forms will provide a better picture of the relationship among the stakeholders during the BM process. This can be because their positions and locations are clear as well as the method of communication.”*

According to our respondents, documentation in a BM department is made through the contractors. Most of the managers are not satisfied with the current documentation and the way of communicating inside the department: they believe that it can be improved. According to Participant (5), he believes that both managers and employees need to be educated in how to use databases, as there is a lack of knowledge in how to handle documents; what they should include and who they should go to. The need for education expressed by Participant (5) is supported by Participant (3): *“Having a system like SharePoint requires that everyone knows its capabilities and how to use it properly.”* A system like SharePoint can make sharing and documentation of information easier in an organization and improve the communication links, however this requires that everyone knows how to utilize it. If these users do not know how to utilize the system, the system loses its purpose. Beckford (1998) stated that systems and procedures can inhibit the pursuit of quality.

When looking at the ISO 9001 model, one of the key characteristics of successfully adopting a QMS is to share, distribute and communicate information and documents. Without proper routines and processes for handling information and documentation, much of the work with quality assurances and improvements may be lost. In a study conducted on ISO certified companies in Saudi Arabia, Magd (2005) found that the three most important benefits gained from applying ISO standards were: improved efficiency of the quality system, better documentation procedures, and increased quality awareness in the organization.

Criteria 4: Speeding up the BM process

Another issue that can be identified is that the proper procedures and templates for BM documentation would improve the current process. According to the interviews conducted in the early stage of this study, there is no mutual process and forms. Without proper routines and processes for handling information and documentation, much of the work with quality assurance and improvements may be lost.

Participant 1: *“From my opinion, this QMS will save BM management time. This is because the QMS overcomes the unneeded interactions that can affect the management time.”*

Participant 5: *“practising the QMS will minimize the possibility of the BM process being delayed. Also, the performance of BM management practices will increase, due to using the QMS forms.”*

According to Dale et al. (2007) and Hallström (2000) the aim of having a quality management system is to create a framework of reference points that ensures that each process within an organization is performed using the same information, methods, skills, and controls and applied in a consistent way. According to Participant (1), to support the work towards quality it is important that a BM process and templates are developed so that consistent documents can be established and stored in a database for mutual supervision and speeding up the BM process.

The lack of consistency in the processes and procedures is alarming, and needs to be attended to in order to support the work towards quality. According to Participant (8), *“There has been a lack of knowledge and information about the processes and procedures that we perform.”* If employees lack knowledge and information about the processes and procedures that are performed, how can quality be achieved? The inconsistency in the processes and procedures that Participants (6) and (7) have experienced is most likely caused by the lack of knowledge and information that Participant (8), pointed out. Participant (5) believes that *“...it will be very good to work towards quality and quality assures those processes and procedures so that we can increase the knowledge of what we are doing. Several improvements have been made to increase quality”*.

In some research studies, such as those by Ruel (2001), Govindaraju (2002) and van Harten et al. (2002), observed that the process of implementation is one of the determining aspects of success in introducing methods into an organisation. From these studies, it is seen that acquiring insights into the process of implementation is important, especially in finding an effective way of transforming the quality management concept and principles into practices throughout the organisation.

Theme 2: Barriers to the QMS implementation

In organizations there will always be forces that act against change and which ultimately will create barriers specific to the change that is to be implemented. Therefore, when implementing a QMS, the barriers that will occur will be specific to the QMS and the organization that implements it. The barriers include the elements of a QMS such as the ISO 9001 standard and can be identified and extracted from the implementation process and the activities and tasks within it.

Generally, the BM participants confirmed that the presentation of the FGS is importance. Most of them clearly recognise the barriers that can be associated with the implementation of each QMS improvement. The QMS barriers issue was the most common item brought up during the focus group discussion and also dominated the discussion, as the issue was perceived as a major hindrance to validate QMS implementation, while the comments of some participants on the QMS barriers merely agreed with the provided lists of QMS barriers as follows:

1. Contractor team collaboration
2. Experienced and qualified people
3. Awareness of quality management practices
4. Resistance to changing the current practice

Criterion 1: Contractor team collaboration

One of the key characteristics of successfully adopting a QMS is to share, distribute and communicate information and documents. Without proper communication and collaboration from the contractors, much of the work with quality assurances and improvements may be lost.

Participant 1: *“It would be difficult to use the QMS in real practice due to the lack of response from the contractors and lack of QM knowledge; this will be one of the barriers for the effective quality management system application. From my experience, some contractors do not pay enough attention to solving the BM problems.”*

Participant 3: *“The QMS will be more effective when applied and practised by certified ISO 9001 Contractors.”*

The hierarchical structure of the contractor organisation should be approved by the BM department and they should clarify the interaction between stakeholders and their inter-relationships. Full implementation requires all internal stakeholders to apply quality standards without doubt to the whole business process of the organisation (Trigunarsyah, Coffey and Willar, 2001). However, for QMS implementation and an approach such as ISO 9001 to be a real solution for both the problems within and the high quality demands of the BM industry involves all levels of BM departments' structure and communication and people's involvement and participation. In addition, the commitment of internal organisational stakeholders is also essential.

Criterion 2: Experienced and qualified people

Education and the development of the competences of the employees should be considered as a very helpful tool. Employees who do not know what is necessary to know about their job are a useless resource to the organization. We need to establish a checklist by which we can check the competence and knowledge level of our employees and educate and train them in the areas of their shortcomings. This will result in a more motivated workforce who feel more comfortable in what they are doing and can deliver a better service. We need a well-developed program in which we go step by step to make sure that they know what is needed to know. The human resources department also has to work closely with the BM departmental managers to create a more specific program for each position.

Participant 4: *“The QMS needs experts to implement it. The Saudi BM industry suffers from shortages in training courses in quality management for engineers. This issue needs to be overcome for the success of the quality management system implementation.”*

Participant 7: *“the QMS based on ISO 9001 standard as a concept is great, however the stakeholders need to have time to understand the ISO 9001 practices in the BM industry, then they can be ready to implement the developed QMS properly.”*

Participant 8: *“The training has a key role to understand and learn how to determine and perform ISO 9001 standards.”*

It is important that every existing employee and every new employee are properly trained when given specific job-tasks and responsibilities. We need a better plan for educating and training staff, which is something that has been poorly executed before. Running training programmes is seen as an added cost, instead of an investment for the BM department.

Another step towards implementing a quality management system is to educate everyone within the organization, highlighting the importance of product and service quality in general, and the underlying reasons for the pursuit of quality (Dale et al., 2007). If the employees on all levels of the organization understand quality, it will generate positive attitudes and behaviours towards ISO 9001 and ultimately encourage their commitment (Dale et al., 2007). A dedicated human resource needs to be trained and guided, while top management needs to be convinced of the rationale and need for an ISO QMS, and understand its potential benefits (Chini and Valdez, 2003; Ahmed et al., 2005).

From the above comments, it can be concluded that the public clients need to understand the methodology of ISO 9001 standards during all the BM activities; then, they have to be qualified enough to implement the QMS. Hence, public clients can overcome this issue by improving their work skills, holding or attending training courses and hiring qualified engineers. This barrier was explored and discussed in the interviews as one of the key issues in the BM industry in SA.

Criterion 3: Awareness of quality management practices

In addition, the participants eventually recognised that to effectively implement the ISO 9001 requirements and the recommendations part of the QMS improvement, this must be

done with a full awareness of the QMS. Some of the main remarks of participants are provided below:

Participant 2: *“public clients’ awareness is not enough yet to establish such a QMS based on ISO 9001 that identifies their positions and responsibilities to manage BM process.”*

Participant 5: *“having unclear terms and conditions in the current public BM contracts that explain the practice of the quality management will be a drawback for the successful implementation of the developed QMS.”*

It is constantly pointed out that lack of awareness of quality management practice is an expected challenge for QMS implementations. This was one of the key outcomes from the interview results. Turk (2006) notes that the development of the QMS requires a huge amount of written documentation and needs a long time to be integrated into organisation management system, leading to potential substantial increases in operating cost.

Criterion 4: Resistance to changing the current practice

The most important barrier seen by respondents was employee resistance. A similar finding was concluded by Psomas et al. (2010). The employee resistance may come from the fear caused by a lack of information about ISO 9001 requirements, and from the belief that it will be difficult to change the mindset of employee regarding quality programs. Therefore, employee understanding of and support for ISO 9001 are critical to its success.

Participant 5: *“The quality management system needs time to learn, which affects the usefulness of it”.*

Participant 7: *“Weakness in making decisions for some public clients’ representatives due to the bureaucracy and fear of responsibility can be a major barrier for the quality management system implementation”.*

In addition, the BM departmental culture may prevent the successful introduction of quality. Adopting a QMS brings changes to the BM departmental culture and it is important to consider how the BM departmental culture should be dealt with. Culture is by

definition “*a set of behavioral and attitudinal norms, to which most or all members of an organization subscribe, either consciously or unconsciously, and which exert a strong influence on the way people resolve problems, make decisions and carry out their everyday task*” (Clutterbuck & Crainer, 1990: 195). In any organization there are entrenched norms of behaviour, as well as certain values and beliefs to which employees conform. Changing the norms that have been established over a long period of time is a very difficult task for any organization and requires managerial and employee commitment and dedication (Beckford, 1998). In addition, the fact that the construction industry has historically been reluctant to deal with changes (Haupt and Whiteman, 2004; Low and Hong, 2005) is reflected in slower implementation of ISO 9001, especially in developing countries.

One of the most important recommendations for organizations is to establish an organizational environment which promotes the development of the QMS according to the requirements of ISO 9001 (Dale et al., 2007). This would include changing the culture of the organization. Senior management should act as quality leaders, because they are the only ones who can deliver the resources and co-operation of selected staff and show the direction in which the company is going (Dale et al., 2007).

8.5 Further Recommendation from the Discussion

Quality management systems help to enhance service quality, providing organisations with means to achieve higher quality processes. The development of QMS should be supported by the use of standards. Standards do not describe a QMS, but formulate requirements which have to be fulfilled by the processes (Pfeifer, 2002a). In the focus group session, the need for further actions to be taken to move forward for effective BM practice was explained to the participants. The results of this session provided extensive feedback on the QMS. Generally, the outcomes of the validation session were positive from the participants; also, they were agreed on the entire proposed BM process and the ISO 9001 requirements.

The top management’s support and commitment should be considered as vital; the entire staff should be included in the process; it is necessary to make preparations of the manual first; make a long-term plan; educate the entire organization; hire qualified consultants to interpret the standard; utilize existing routines as a starting-point, establish a common plan

of action; do not set up a quality department; and distribute responsibility to line members. (Carlsson & Carlsson, 1994). What is certain is that senior managers play a major role in promoting the use of the new implementation in daily BM activities; attempts to secure such commitment and to increase general awareness and knowledge of departmental staff concerning the value of using the quality management system through offering training to the teams involved would enhance the quality management system's usefulness.

The participants recommended that the maintenance contractor should assist and support the implementation of QMS. Also, it is recommended that the maintenance contractor is seen as a key player responsible for the outcomes of BM process management and implementation. Hence, the maintenance contractor is required to follow the ISO 9001 standards and use the developed forms to provide a documentation process for the client. As result, good documentation would help to minimize the potential problems in the future, due to the lessons learned and building up their knowledge from the previously implemented maintenance work orders. Moreover, the public client is recommended to work closely with the maintenance contractor to guarantee the highest efficiency in archiving and documenting maintenance work orders.

The FGS results also reveal that, as indicated in some earlier studies, the main motivation for adopting ISO 9001 was to have an effective tool for improving quality management procedures in organizations (Chini and Valdez, 2003; Turk, 2006). Carlsson & Carlsson (1994) found that the Swedish organizations in their study had the most difficulty with consumption of time and resources. Carlsson & Carlsson (1994) concluded that this showed the fundamental problems for any organization in allocating the right amount of resources and necessary time on implementing a QMS such as ISO 9001. The author also found that the participants had problems understanding and interpreting the standards of ISO 9001 and that it provided too much bureaucratic documentation with little room for flexibility.

Thus, a structure for a BM department and contractors that will facilitate the adoption of a QMS is key in a successful implementation. The structure includes functions, roles, responsibilities, hierarchies and boundaries. If the roles and responsibilities stipulated in quality policies are not uniform with the original roles and responsibilities there is a risk that employees and managers will reject the ownership of the quality processes. Conclusion

This chapter has discussed the results of the evaluation and validation of the quality management system, from which it is shown that the majority of the comments received during the focus group session comprised of eight BM industry professionals were positive, but that some concerns were expressed about the capability of BM stakeholders to implement it. Moreover, through one focus group session the enablers of and barriers to the QMS application were identified. All the participants expressed the opinion that it was feasible to implement the proposed QMS in the field and expected that there would be tangible benefits from it. From the analysis of the feedback, the QMS was found to be applicable and relatively clear to be applied in the Saudi public BM industry.

The chapter has shown the validation of the quality management system involving industry experts with no prior involvement in the research, and hence no biased opinions on the way in which the quality management system was developed. From that validation process the quality management system has emerged as a step forward in alerting BM departments to the need for systematisation in practice as a means of improving quality.

In the above feedback regarding the likely success of the QMS implementation, the participant's showed their belief that it is indeed appropriate for BM industry. Hence, it can be claimed that the quality management system has been validated in its intention to provide the BM industry with a set of guidelines that have relevance for real world practice. Most of the participants considered the quality management system to represent a way of improving communication between all parties to the BM process.

Chapter 9: Conclusion and Recommendations

9.1 Introduction

The aim of this research study was to investigate the Quality Management System (QMS) required to improve Saudi public Building Maintenance (BM) practices through the implementation of the most suitable and effective Quality Management Concepts (QMCs). This aim has been achieved through the completion of the six stages detailed in the thesis, namely the literature reviews, exploratory interviews, focus group sessions, quality management system development, the validation of the developed quality management system, and finally, recommendations. This chapter summarises the evolution of the research and emphasises the major findings in relation to the objectives stated in Chapter One. In addition, it discusses the contribution the study makes to existing knowledge in the field. Finally, it identifies the limitations of the study, and makes recommendations for future research.

9.2 Meeting the Research Aim and Objectives

The research main aim was met by developing a quality management system based on the basic principles of ISO 9001 to improve the BM process for better management and reduce the common problems of orders in the Saudi public BM industry, which were discussed in Section 5.4. This was accomplished by different methods carried out for the purpose of the research, starting from a comprehensive literature review, then investigating the current practice, followed by selecting the most effective quality management concepts. The next stages involved developing the quality management system and finally QMS validation. The developed QMS has the potential to help the BM public client to become engaged effectively in the BM process and to overcome the barriers associated with the current practice. Figure 10.1 depicts how each objective has been achieved as the stages of the research have unfolded.

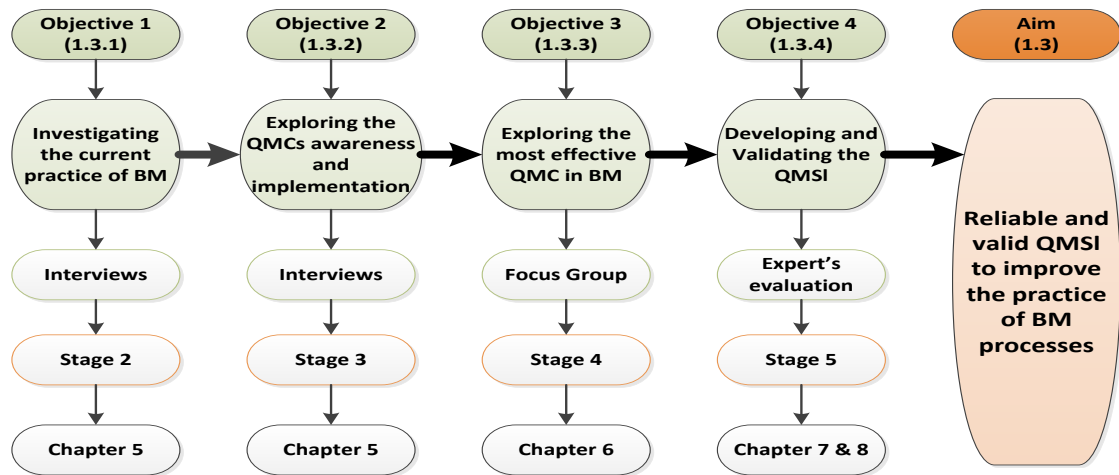


Figure 10.1: Achievement of Research Objectives in the Different Stages of the Study

Objective One: “To examine the current business processes in the building maintenance department, with a view to ascertaining underlying problems and potential areas for improvement”

The review of the literature showed a lack of research studies, and hence, knowledge and understanding, that have investigated the process of BM in the Saudi Arabian public sector. This absence has been acknowledged by several local scholars (e.g. Hassanain and Al-Saadi, 2005; Hussayien, 1980; Ahmad, 1995; Talal, 1995; Al-Arjani, 1995; Al-Hammad et al., 1995; and Arafah et al., 1995) and, as explained in Chapter Two, it was this gap in current understanding that motivated the researcher to conduct a series of exploratory interviews to determine the state of BM procedures in the public sector. The data collection process in this respect (semi-structured interviews with practitioners from 12 different public BM departments) was reported in Chapter Four and the findings from that process (interpreted using the approach of thematic analysis) were presented in Chapter Five. From these findings, the researcher came to understand the processes performed in BM departments, and was able to identify deficiencies in quality management.

A generic BM process diagram was subsequently mapped by the researcher according to the data obtained, and in this a block flowchart technique was used to reveal the activities conducted within BM departments, and the common problems affecting these processes. The processes associated with BM services involve three main parties: owners,

maintenance management teams, and contractors. Several findings emerged from the analysis of the BM process. The first was that it was possible to establish several potential ways in which the problems affecting the smooth running of the overall process, could be managed effectively. Hence, by indicating how certain problems could be solved, the BM diagram assisted in improving the business process.

The major problems were classified into three groups: senior management, human resources, and technical. Specifically, the interviewees emphasised the lack of top management support, poor management of the maintenance team, poor procurement management, unqualified maintenance contractors, financial issues, lack of supervision of the maintenance team, and lack of stakeholder communication and engagement and interaction during the BM process, all of which were seen to lead to poor BM practice. Furthermore, it was revealed that stakeholders' responsibilities were not sufficiently clear. These issues were taken into account in the subsequent activities of the study. In fact, the existing generic BM process within the Saudi Arabian public sector organisations revealed that little or no attention was being paid to the significance of the need to link quality management principles with the current practice of BM.

The complete solution to these various problems goes beyond the capability of the QMC finally adopted - the ISO 9001 standard – but the implementation of the ISO 9001 in the Saudi Arabian BM industry was judged to be more effective to improve the current practice.

Objective Two: “*To explore QMCs with a view to understanding the level of awareness they enjoy among practitioners, and their applicability to public BM departments*”

The review of the literature revealed an absence of research related to quality management in the Saudi Arabian BM industry. Therefore, this stage of the study concentrated on exploring the current understanding and awareness of quality management concepts in that particular context.

This objective was achieved through a detailed analysis of the existing understanding of five QMCs, these being: TQM, Six Sigma, Lean Management, Lean Six Sigma, and the ISO 9001 standards. From this analysis it was found that the majority of participants

lacked knowledge and awareness of any QM practices currently implemented in the Saudi public BM industry. Consequently, it was understood that the BM industry was not obtaining any of the potential benefits resulting from the implementation of QM. The major reasons for the lack of attention paid to QMCs were cited as being the absence of regulation requiring this, the lack of experience within the industry to work with such concepts, and the high expenditure which the introduction of any kind of QMC would imply. This part of the study enabled the researcher to better understand the needs of any QMC proposed for implementation within BM departments in Saudi Arabia's public sector.

Objective Three: “*To establish the most suitable and effective QMCs for implementation in BM departments*”

This objective was achieved by conducting a qualitative study involving four focus group sessions in which 19 practitioners, and two consultants participated. Each session lasted for two hours, and members were introduced to the five QMCs and then asked to discuss their opinions about the applicability of each of these for implementation in their departmental practice. All the participants provided insight into the effectiveness of these QMCs, although some were hardly known to them, from a practical perspective. The data gathered were analysed thematically, the outcome being a preference for the ISO 90001 standard which was believed to provide a baseline, and have the capacity to develop and improve the BM processes.

The focus group sessions also confirmed the generic BM process diagram for use as guidance within the Saudi BM public sector, and offered a consensus of opinion regarding the usefulness and applicability of the diagram.

Objective Four: “*To develop and validate an appropriate quality management system for BM in order to improve business processes*”

To achieve the fourth objective of the research, a quality management system, based on the ISO 90001 standard was developed and customised as a means of developing and improving the operation of BM projects by solving the problems highlighted in this study. The quality management system was then presented to eight experts via a focus group

session at the OMAINTEC 2014 conference, and the feedback concerning the quality management system was largely positive. This objective was achieved by conceptual testing the clarity and applicability of the developed QMS to ensure this QMS would add value to the Saudi public building maintenance industry. Overall, the members believed the quality management system would lead to better BM management, and improved communication between all parties.

Moreover, the enabler of and implement to application of the developed QMS were identified through this focus group session. All participants expressed their opinions that it was feasible to implement this QMS in the field and expected that there would be tangible benefits from it. From the feedback of the analysis, the QMS was found to be applicable, effective and relatively clear to be applied in the Saudi public BM industry.

9.3 Research Contribution

This research study has developed a quality management system based on the ISO9001 Standard. This will contribute to saving the BM industry management time, improving the communication and relationships among stakeholders and improving quality within BM departments in Saudi Arabian public sector organisations, and is a novel facility. The research provided an extensive review of the Saudi BM industry in terms of the BM practices. It has therefore identified an existing gap in knowledge with regard to the BM current practice. Furthermore, this research has developed a guideline for ISO 9001 standard implementation that links the developed QMS with BM processes for better practice in the Saudi public BM industry. This results in a contribution to the overall body of knowledge which can be outlined as follows:

- The study has developed the generic BM diagram shows clarifying the stakeholders' responsibilities and communication link during the BM management process, and identified the related common problems in BM industry in SA.
- In developing the QMS, the study also contributes to the knowledge on the level of QMC awareness in the BM industry in SA, and also by selecting the most suitable and effective QMC to be applied the current practice which was ISO 9001 standard.
- The study has developed quality management system as guideline to use the proposed forms within the generic BM process, with the aim of engaging all parties involved in managing BM services and improving the communications links.

- Providing a deep understanding of the availability and effectiveness of QMS based on ISO 9001 standard. This can provide a solid ground for future studies and an understanding of the current practices of ISO 9001 standard.

9.4 Limitations of the Research

This research has some limitations in terms of its conduct and scope as briefly addressed below:

- The study intended to exclude contractors and suppliers, in order to allow for an in-depth investigation of the client's perspective only.
- Complexity in arranging a suitable time for the experts to conduct the interviews and focus group sessions.
- The developed QMS was not implemented in a real life project to assess how it will perform in the BM process and stages, due to the difficulty in getting approval from the participants and tanks months for implementation.
- in Saudi Arabia are not yet clearly identified, and also the practice of quality management system is not yet well established in building maintenance industry, thus one of the research limitations is that the results may not be easily adapted to all building maintenance projects, as it is specific for the governmental sector (the client).
- The methodology of this study that includes the exploratory interviews stage, because of time constraints, the researcher could only conduct 12 interviews to investigate the current practice of Saudi building maintenance industry. This can be attributed to the fact that, there was a difficulty in reaching the BM experts who work in public sector, due to the shortage of information about them, such as names, addresses, and contact details.
- The developed QMS was built based on primary data collected from the Saudi Building Maintenance industry, and the QMS was validated by experts from the Saudi Arabia. Therefore the framework would not be guaranteed valid for use in other countries. Due to the availability and effect of the techniques and approaches

used, the structure of the organisation, its culture, the approaches to motivation, organisational resources, etc. results may differ from country to country.

9.5 Recommendations for Future Research

The limitations just identified form the basis of recommendations for further study as follows:

- The methodology could be applied to other studies in Saudi Arabia and elsewhere to focus on the perspectives of contractor to the BM process. The involvement of the contractor would enable a comprehensive picture to be gained of all stakeholders, and potentially facilitate agreement regarding the implementation of a particular QMC or set of QMCs to improve BM delivery.
- The developed QMS could be implemented and improved in a future study based on qualitative methodology, such as Case Study for more exploration and improvements. This can be achieved through regular meetings with practitioners to articulate their experience.
- It is anticipated that the outcomes of this research could be extended to other countries where the business environment is similar to that in Saudi Arabia such as in other Gulf Co-operation Countries (GCC).
- The developed QMS could be implemented and improved in a future study based on qualitative methodology, such as Case Study for more exploration and improvements. This can be achieved through regular meetings with practitioners to articulate their experience.

This study covers only the preparation stage of the implementation of a QMS and consequently a study in the same case BM departments should be made to determine how the implementation of the QMS turned out and whether this study provided sufficient preparation for the BM.

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Appendix A

Building Maintenance Process (Individual Interviews).

The following is the interview guide that the researcher will use with key staff, to determine what they found to be the strengths and weaknesses of the initiative.



21st September, 2011

Subject: Request for Permission and cooperation in obtaining information

Dear Sir,

Eng. Ayman Rashed Al-Shehri is a doctoral student at Heriot-Watt University. The title of his research is "*Implementing the effective concept of quality management in building maintenance departments in Saudi Arabia*". The research aims to provide an approach to implement the principles of the most suitable quality management concepts for improving building maintenance practice.

The research work will require extensive gathering of relevant data to Building Maintenance Process. The method for this purpose will include interviews, focused group, etc. Therefore, it is hoped that your support and cooperation will enable the student to gather the required information and provide a useful contribution for both the knowledge and business strategy. For such purpose, Eng. Ayman Al-Shehri and the research supervisors would like to ask for your permission and support in obtaining information on projects developed through building maintenance by your department.

Please be assured that any given information will be treated as strictly confidential and used only for academic purposes, where your name and/or your organization name will not be mentioned explicitly/directly in this study unless you permit to do so. In fact, the focus will be towards collecting data that leads to results that could assist in achieving this study's aim.

The research team will be pleased to send to you a summary of the results as soon as they become available in case you wish to do so. Please do not hesitate to ask any question to the research team.

Thanking you in anticipation of your kind consideration.

Yours faithfully,


Dr. Ibrahim Motawa
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First Supervisor


Professor Stephen Ogunlana
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Methods	Questions	Prompts
Introduction Key Components: <ul style="list-style-type: none"> • Thank you • Your name • Purpose • Confidentiality • Duration • How interview will be conducted • Opportunity for Questions 	<p>Greeting:</p> <p>I want to thank you for taking the time to meet with me today. My name is Ayman Rashed Al-Shehri and I would like to talk to you about your experiences participating in the <i>Building Maintenance Processes and Issues related.</i> Specifically, I am doing my PhD study about develop and improve the performance of building maintenance departments by using the suitable quality management concepts such as (TQM, Sig sigma, Lean thinking, ISO 9000 and Lean Six Sigma). The interview should take around an hour. I will be taping the session because I don't want to miss any of your comments. Although I will be taking some notes during the session, I can't possibly write fast enough to get it all down. All responses will be kept confidential. This means that your interview responses will only be shared with research team members (Two Supervisors) and I will ensure that any information we include in my study does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.</p> <ul style="list-style-type: none"> • Are there any questions about what I have just explained? • Are you willing to participate in this interview? 	
Simi-structured Questions: <ul style="list-style-type: none"> • No more than 5 open-ended questions • Ask factual before opinion • Use probes as needed 	<p>What are the current BM processes in your department from start to end? With explanation in more details?</p> <p>What are the key stages in the processes? Could you explain? And is there chance to develop?</p> <p>What are the common problems (human and technical) during the processes?</p>	Objective (1)

<p>Simi-structured Questions:</p> <ul style="list-style-type: none"> • No more than 5 open-ended questions • Ask factual before opinion • Use probes as needed 	<p>What is your understanding and prospective about QM concepts? (TQM, Six sigma, Lean thinking, ISO 9000 and Lean Six Sigma).</p> <p>Are you aware about these concepts, application and their benefits?</p> <p>What do you know about (TQM, Six sigma, Lean thinking, ISO 9000 and Lean Six Sigma) in term of definition, application, methods and benefits?</p>	<p>Objective (2)</p>
<p>Simi-structured Questions:</p> <ul style="list-style-type: none"> • No more than 5 open-ended questions • Ask factual before opinion • Use probes as needed 	<p>Do you apply any of these concepts in your departments?</p> <p>If yes, which concepts you have been applied? How do you measure the performance? What are the successes factors for implementation?</p> <p>If not, what are the barriers for implementation?</p> <p>How did you overcome the barrier(s)?</p> <p>What QM concept, tools, etc, would you recommend be useful and/or effective? Please provide a justification for your response?</p> <p>What recommendations do you have for future efforts such as these?</p>	<p>Objective (3)</p>
<p>Closing Key Components:</p> <ul style="list-style-type: none"> • Additional comments • Next steps • Thank you 	<p>Is there anything more you would like to add?</p> <p>I'll be analyzing the information you and others gave me and submitting a draft report to the organization in three months. I'll be happy to send you a copy to review at that time, if you are interested.</p> <p>Thank you for your time.</p>	

Table I: Building Maintenance Process (Individual Interviews).

Appendix B

Focus Groups Research Technique

Focus Groups Purpose

The focus group is a type of group interview. The goal of focus groups is to encourage interaction between participants on a series of topics. Focus Groups are best when used to generate ideas and stimulate discussion about a new concept. The method therefore seemed appropriate for an exploratory investigation. In this study, there are five quality management concepts to be under discussion to answer two questions as discussed below. This method is particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way.

Arrangements for Focus Groups session

Invitations: Participants will be contacted in advance, at least one to two weeks before the session. A letter of invitation may be sent to each participant, taking into consideration the prevailing practices in the area. Participants are also reminded about the focus group discussion one day before the session.

Venue: Focus group discussions will be conducted in a place where 8 - 10 persons can be seated and assured of some privacy. An appropriate venue is a neutral place that is free from distractions and where participants can talk openly. The meeting room in four or five stars hotel would be reserved for the session. This meeting room has a projector and screen for the presentation. Providing nametags to participants will be prepared by the hotel's reception because it enables facilitators to call on those who may be too shy to express their opinions.

Refreshments: Even when incentives are provided, such as refreshments after the session is a small gesture of appreciation to the participants for having taken time off their work to participate.

Workshop to discuss

What is the appropriate and the most effective quality management concepts that can be applied in the maintenance and operation departments in government buildings?

Objectives of the FGD

Present and discuss of the five concepts of quality (TQM, six sigma, lean management, lean six sigma and ISO 9000) and its applicability to the maintenance operations? Why?

Offer some solutions to the problems of maintenance of government buildings

Select the most appropriate concept of quality and viable in the M&O departments.

Participants in the FGS

Attending 6 directors from maintenance and operating departments of the government sector, their range experience from (15-25) years.

Attending an internationally certified expert in Six Sigma, Lean and ISO.

Attending the director of the quality system in the Saudi Standards, Metrology and Quality Organization (SASO) that are interested in quality applications in the public sector.

Interest of FGS to attend

Link with maintenance managers in the same field in other governmental sectors.

Acquisition of knowledge from the experiences of other managers

Exchange card with an expert from SASO

Take advantage to know the expert in Six Sigma, Lean and ISO

FGS Schedule

Present the concepts of quality for **15 minutes.**

Discuss from the practical perspective to determine the best and most suitable concept of quality can be applied for **60 minutes.**

Provide **Coffee Break & Dinner (open buffet)** during and after the discussion.

Time and place of the FGS

Hall of the Paris, Novatel Hotel (**5 stars**) in the Alanoud Tower.

On Monday (21/3/1433 H, 13/2/2012).

The meeting starts at 8 pm (1:30 hour duration of the meeting).

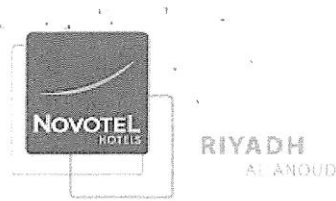
Contact Info

Name: Ayman Rashid Al-Shehri

Mobile: 0553112399

Email: ara22@hw.ac.uk

Quotations form Hotel for FGD



MEETING CONTRACT

BETWEEN: Novotel Riyadh Al Anoud

AND

CLIENT: Heriot – WATT University

To:	Mr. Ayman Shehri	From:	Wael J. Saliem
Company:	Heriot – WATT University	Date:	28 / 02 / 2012
Tel:		Tel:	01 – 288 2323
Fax:		Fax:	01 – 288 2231
Mobile:	+966 553 112 399	Mobile:	+966 568 888 371
Email:	ara22@hw.ac.uk	Email:	h6532-sl3@accor.com
Reference:	NAA / 0240 / 12	CC:	Mr. Mohsin Khalil

We are very pleased to offer our services under the terms and conditions herein and would like to thank you for choosing Novotel Riyadh Al Anoud HOTEL.

We agree to provide Meeting room facilities as follows:

Half Day Conference Meeting for people	Dates : 05 March' 2012 08 pax (Paris II Meeting Rom, Mezzanine Floor) upon subject to availability at the time of confirmation	Delegate Rate: SAR 200 NETT per Person, inclusive of 01 Coffee Break & Dinner. Dinner will be served @ "La Croisette" restaurant.
Timings :	TBA	
Set Up :	Round Tables	

Additional requirements: LCD projector, Screen, Pens, Pads, Flipchart & A / V System.

TERMS AND CONDITIONS - MEETING

Article 1: Status of Attendees

- ❖ Please note that special permission from the concerned authorities (Emaara) is needed if the event falls under any of the following categories:
 - Mixed Events (Ladies & Gents attendees)
 - Ladies only event.
 - Any product exhibition.
 - Any presentations that include products shown, used or launched during the event.

Article 2: Nullifying the Contract

The Hotel reserves the right to change venues according to operational requirements without prior notification.

The Hotel reserves the right to cancel any confirmed event without prior notification if the Hotel venue is requested for a Royal event without any prejudice whatsoever.



RIYADH
AL ANOUD

MEETING CONTRACT

BETWEEN: Novotel Riyadh Al Anoud

AND

CLIENT: Heriot – WATT University

To:	Mr. Ayman Shehri	From:	Wael J. Saliem
Company:	Heriot – WATT University	Date:	30 / 01 / 2012
Tel:		Tel:	01 – 288 2323
Fax:		Fax:	01 – 288 2231
Mobile:	+966 553 112 399	Mobile:	+966 568 888 371
Email:	ara22@hw.ac.uk	Email:	h6532-sl3@accor.com
Reference:	NAA / 0070 / 12	CC:	Mr. Mohsin Khalil

We are very pleased to offer our services under the terms and conditions herein and would like to thank you for choosing Novotel Riyadh Al Anoud HOTEL

We agree to provide Meeting room facilities as follows:

Half Day Conference Meeting for people	Dates: 13, 20 & 27 February' 2012 08 pax (Paris I Meeting Rom, Mezzanine Floor) upon subject to availability at the time of confirmation	OPTION I Delegate Rate: SAR 180 NETT per Person, inclusive of 01 Coffee Break only.
Timings :	TBA (5 - 11 pm)	OPTION II ✓ Delegate Rate: SAR 210 NETT per Person, inclusive of 01 Coffee Break & Dinner.
Set Up :	Round Tables	Dinner will be served @ "La Croisette" restaurant.

Additional requirements: LCD projector, Screen, Pens, Pads, Flipchart & A / V System.

TERMS AND CONDITIONS - MEETING

Article 1: Status of Attendees

- ❖ Please note that special permission from the concerned authorities (Emaara) is needed if the event falls under any of the following categories:
 - Mixed Events (Ladies & Gents attendees)
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AL ANOUD

MEETING CONTRACT

BETWEEN: Novotel Riyadh Al Anoud

AND

CLIENT: Heriot – WATT University

To:	Mr. Ayman Shehri	From:	Wael J. Saliem
Company:	Heriot – WATT University	Date:	15 / 02 / 2012
Tel:		Tel:	01 – 288 2323
Fax:		Fax:	01 – 288 2231
Mobile:	+966 553 112 399	Mobile:	+966 568 888 371
Email:	ara22@hw.ac.uk	Email:	h6532-sl3@accor.com
Reference:	NAA / 0070 / 12	CC:	Mr. Mohsin Khalil

We are very pleased to offer our services under the terms and conditions herein and would like to thank you for choosing Novotel Riyadh Al Anoud HOTEL

We agree to provide Meeting room facilities as follows:

Half Day Conference	Dates : 19 & 27 February' 2012	OPTION I
Meeting for people	06 - 08 pax (Paris I Meeting Rom, Mezzanine Floor) upon subject to availability at the time of confirmation	Delegate Rate: SAR 180 NETT per Person, inclusive of 01 Coffee Break only.
Timings :	1900 – 23 :00	OPTION II
Set Up :	Round Tables	Delegate Rate: SAR 240 NETT per Person, inclusive of 01 Coffee Break & Dinner. Dinner will be served @ "La Croisette" restaurant.

Additional requirements: LCD projector, Screen, Pens, Pads, Flipchart & A / V System.

TERMS AND CONDITIONS - MEETING

Article 1: Status of Attendees

❖ Please note that special permission from the concerned authorities (Emaara) is needed if the event falls under any of the following categories:

- Mixed Events (Ladies & Gents attendees)
- Ladies only event.
- Any product exhibition.
- Any presentations that include products shown, used or launched during the event.

Article 2: Nullifying the Contract

The Hotel reserves the right to change venues according to operational requirements without prior notification.

The Hotel reserves the right to cancel any confirmed event without prior notification if the Hotel venue is requested for a Royal event without any prejudice whatsoever.

Novotel Al Anoud hotel – 9033, King Fahd Road, Olaya – unit No. 1, Riyadh 12214 – P.O. Box 2370, Kingdom of Saudi Arabia
Tel: +966 1 288 2323 – Fax: +966 1 288 2231 – www.novotel.com – www.accorhotels.com

1/4

Novotel Riyadh Al Anoud

Al Anoud Tower No. 1
9033 King Fahad Road, Olaya
P.O.Box 2370 Riyadh 12214
Kingdom of Saudi Arabia.
Phone :+966 01 288 2323
Fax :+966 01 288 2231



RIYADH
AL ANOUD

For Metting on 13-02-12 Ayman Al Shahri

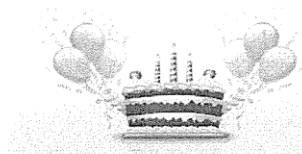
a
Saudi Arabia

Folio No.	:	Room No.	:	9022
Cashier Name	:	Rate Amount	:	0
Date Printed	:	Arrival	:	04-FEB-12 09:56:00
		Departure	:	13-FEB-12 00:00:00
		No. Of Person	:	0 / 0
		Page No.	:	1 of 1

Date	Description	Charges SAR	Credits SAR
04-02-12	SPAN		1,680.00
	XXX5545 XX/XX		
Total		0.00	1,680.00
Balance		-1,680.00 SAR	

Guest Signature

Thank You for Visiting Novotel Anoud, Riyadh



It's **AI CLUB** 3rd birthday
and we're offering you
1,000 bonus points!

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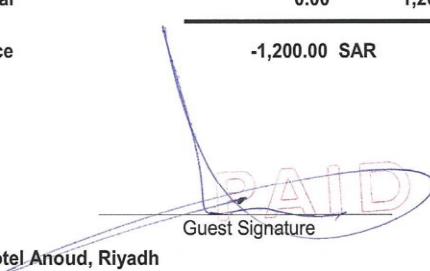
RIYADH
AL ANOUD

Heriot -Watt University Ayman Shehri
For Metting room on 19-02-12
Saudi Arabia

Room No. : 9052
Rate Amount : 0
Arrival : 15-FEB-12 16:55:00
Departure : 19-FEB-12 00:00:00
No. Of Person : 0 / 0
Page No. : 1 of 1

Folio No. :
Cashier Name : HANI
Date Printed : 15-FEB-12 16:58:29

Date	Description	Charges SAR	Credits SAR
15-02-12	Visa Card XXXXXXXXXXXX2182 XX/XX		1,200.00
Total		0.00	1,200.00
Balance		-1,200.00 SAR	


Guest Signature

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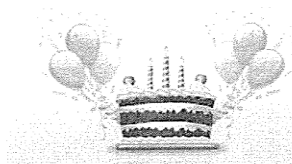
Heriot -Watt University Ayman Shehri
For Metting room on 19-02-12
Saudi Arabia

Folio No.	:		Room No.	:	9052
Cashier Name	:	REFAT	Rate Amount	:	0
Date Printed	:	19-FEB-12 23:17:31	Arrival	:	15-FEB-12 16:55:00
			Departure	:	19-FEB-12 00:00:00
			No. Of Person	:	0 / 0
			Page No.	:	1 of 1

Date	Description	Charges SAR	Credits SAR
15-02-12	Visa Card XXXXXXXXXXXX2182 XX/XX		1,200.00
19-02-12	Visa Card XXXXXXXXXXXX2182 XX/XX		600.00
Total		0.00	1,800.00
Balance		-1,800.00 SAR	

Guest Signature

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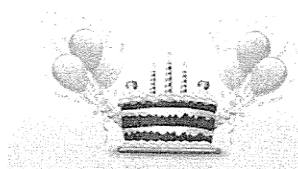
RIYADH
AL ANOUD

Heriot University For Metting room Shehri Ayman
Heriot
Saudi Arabia

		Room No.	: 9035
		Rate Amount	: 0
		Arrival	: 27-FEB-12 21:35:00
		Departure	: 27-FEB-12 21:39:00
		No. Of Person	: 0 / 0
		Page No.	: 1 of 1
Folio No.	: 11128		
Cashier Name	: HANI		
Date Printed	: 27-FEB-12 21:39:21		
Date	Description	Charges SAR	Credits SAR
27-02-12	Banquet Meeting Food	1,000.00	
	4328		
27-02-12	Visa Card		1,000.00
	XXXXXXXXXXXX2182 XX/XX		
Total		1,000.00	1,000.00
Balance		0.00 SAR	

PAID
Guest Signature

Thank You for Visiting Novotel Anoud, Riyadh



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Fax :+966 01 288 2231



RIYADH
AL ANOUD

Aymen Shehri (Watt University)
Saudi Arabia

Folio No.	:	Room No.	:	9057
Cashier Name	:	Rate Amount	:	0
Date Printed	:	Arrival	:	06-MAR-12 17:02:00
		Departure	:	06-MAR-12 00:00:00
		No. Of Person	:	0 / 0
		Page No.	:	1 of 1

Date	Description	Charges SAR	Credits SAR
06-03-12	Visa Card		1,200.00
	XXXXXXXXXXXX2182 XX/XX		
06-03-12	Visa Card		400.00
	XXXXXXXXXXXX2182 XX/XX		
Total		0.00	1,600.00
Balance		-1,600.00 SAR	

Guest Signature

Thank You for Visiting Novotel Anoud, Riyadh



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Appendix C

Maintenance Work Forms

[QF 1 Request for Document Change](#)
[QF 2 Employee Satisfaction Survey Form](#)
[QF 3 Operational Plan form](#)
[QF 4 Job Description form](#)
[QF 5 Management Review Report](#)
[QF 6 Minutes of the meeting form](#)
[QF 7 Meeting agenda form](#)
[QF 8 Performance Development Review](#)
[QF 9 Purchasing Order Form](#)
[QF 10 Internal Audit Report](#)
[QF 11 Non-conformity Report](#)
[QF 12 Corrective Action Request](#)
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[QF 18 Weekly Preventive Maintenance Form for Electricity](#)
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REQUEST DOCUMENT CHANGE FORM

QF 1	REVISION 00	2014
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QF 1 REQUEST FOR DOCUMENT CHANGE (RDC)

Date: _____ RDC No.: _____

Originator: _____

Document Title: _____

Page and/or Paragraph Number: _____

Description of Changes Recommended (Define in Detail):

Comments: _____

Department Manager Remarks: _____

Approved By: _____ Date: _____

PROCEDURE FOR COMPLETING FORM

- 1) Complete top section of this form except for RDC number
- 2) Obtain Department Manager's approval
- 3) Forward original to Document Control section who will assign RDC number (Note: one copy will be returned to originator with RDC number assigned. If problem involves safety, effectiveness or reliability, a copy of the originator with RDC number assigned will be forwarded by Engineering to QA Manager.
- 4) Document Control section will take action and if appropriate will proceed with an RDC.
- 5) Document Control section returns a copy to Originator upon resolution of request.

Distribution: Original - RDC File Copy 1 - Originato

QF 2	REVISION 00	2014
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REVISION 00

Kindly complete this form to be able to improve its performance and services.

[illegible]

Job Description

QF 4	REVISION 00	April 2012
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Job Title:
Job ID:
Job Function:

Job Requirements

متطلبات الوظيفة

.....
.....
.....

Direct operational tasks:

المهام التنفيذية المباشرة :

.....
.....
.....
.....

Skills and abilities

المهارات والقدرات

1.
2.
3.
4.

The Qualifications:

المؤهلات العلمية :

1.
2.
3.
4.

Approval	Maintenance Manager	الاعتماد
----------	---------------------	----------

	MANAGEMENT REVIEW REPORT			
	Issued by: QMR	Effective Date:	Revision: 0	QF 5

Management Review Report

Date

Period

From

to

Participants
(name & title):

Agenda:

1. Follow-up actions from previous reviews

2. Process performance and product conformity

3. Corrective and preventive actions

4. Customer feedback and complaints

5. Internal quality audits

6. Changes and quality system planning

7. Recommendations for Improvement

8. Quality objectives and quality policy

Quality Objectives established by this management review

Objective	Measure	Previous Period	Previous Period Value	Next Target Period	Next Target Value	Status Next Mngmt Review

	MANAGEMENT REVIEW REPORT					
	Issued by: QMR	Effective Date:	Revision: 0	QF-5		

Topic 1: <i>Follow-up actions from previous reviews</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 2: <i>Process performance and product conformity</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 3: <i>Corrective and preventive actions</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

	MANAGEMENT REVIEW REPORT			
	Issued by: QMR	Effective Date:	Revision: 0	QF-5

Topic 4: <i>Customer feedback and complaints</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 5: <i>Internal quality audits</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 6: <i>Changes and quality system planning</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 7: <i>Recommendations for improvement</i>				
--	--	--	--	--

	MANAGEMENT REVIEW REPORT			
	Issued by: QMR	Effective Date:	Revision: 0	QF-5

Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 8: <i>Quality objectives and quality policy</i>				
Item #	Description/Conclusions	Action	Assigned to	Due date

Topic 9:				
Item #	Description/Conclusions	Action	Assigned to	Due date

Minutes OF Meeting

QF 6	REVISION 00	2014
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Attendees:

(1)	A	(9)	P
(2)	P	(10)	P
(3)	A	(11)	P
(4)	P	(12)	P
(5)	P	(13)	P
(6)	A	(14)	P
(7)	P	(15)	P
(8)	A	(16)	

#	Chapter 10Task	Responsible & actions	Due Date
<u>Subject 1</u>			
(1)			
<u>Subject 2</u>			
(1)			
<u>Subject 3</u>			
(1)			
<u>Subject 4</u>			
(1)			

MEETING AGENDA

QF 7	REVISION 00	2014
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Meeting	10.1.1.1 Weekly meeting		
Date of Meeting:	10.1.1.2	Time:	10.1.1.3
		Location:	10.1.1.4

Agenda Items		
Topic	Owner	Duration

طلب شراء نقدي

رقم الطلب :		تاريخ الطلب / / 143 هـ	
القطع المطلوبة	أسم القطعة		
		
		
		
		
		
الجهة الطالبة		توقيع الجهة الطالبة :	
<p>سعادة مدير عام</p> <p>المحترم</p> <p>السلام عليكم ورحمة الله وبركاته</p> <p>بناءً على الحاجة الماسة للمواد أعلاه أمل موافقة سعادتكم على تأمينها</p> <p>رئيس القسم المالي والإداري التاريخ : / / 143 هـ</p> <p>التوقيع :</p>			
موافقة المدير العام		<p>سعادة / رئيس القسم المالي والإداري</p> <p>المحترم</p> <p>لا مانع من شراء المواد المذكورة أعلاه .</p> <p>التوقيع مدير عام</p>	
التوجيه بالشراء		<p>الأخ مندوب المشتريات</p> <p>وآمل تأمين المطلوب حسب توجيه المدير العام.</p> <p>رئيس القسم المالي والإداري</p>	
تأمين المشتريات وتسليمها للجهة الطالبة		<p>سعادة / رئيس القسم المالي والإداري</p> <p>المحترم</p> <p>السلام عليكم ورحمة الله وبركاته:</p> <p>لقد تم تأمين المطلوب من () بسعر إجمالي قدره ()</p> <p>ريال فقط وفقاً لما ورد في الفاتورة رقم () وتم تسليم المواد الى الجهة الطالبة لإنهاء اجراءات الفحص والإستلام والتسليم .</p> <p>التاريخ / / 143 هـ</p> <p>مندوب المشتريات</p> <p>الأسم :</p> <p>التوقيع :</p>	

INTERNAL QUALITY AUDIT REPORT

QF 10	REVISION 00	2014
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	Issued by: QM	Date: 2014	Revision:	QF 10

QMS Process:

Audit Date:

IQA #:

Area/Operation:

Auditor:

No of CAR
raised:

ISO 9001:2008

Sections:

FINDINGS:

RECOMMENDATIONS:

SIGNED: INTERNAL AUDITOR:-----

NAME:-----

PEOCEDURAL NONCONFORMITY REPORT

QF 11	REVISION 00	2014
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PEOCEDURAL NONCONFORMITY REPORT			
Issued by: QA	Date:	Revision:	QF 11

QMS Process:	<input type="text"/>	Date:	<input type="text"/>	Finding #:	<input type="text"/>
Area/Operatio	<input type="text"/>	NC reported	<input type="text"/>		
Reference:	<input type="text"/>	ISO 9001:2008	Section <input type="text"/>		

Description of Nonconformity	Category (Tick One) Customer Complaint / Internal (Major/Minor)
QC/QMR	Date:
Assign Owner (Department/person responsible)	
Manager/QMR	Date:
Accepted/Not Accepted (cross out one)	
Department	Date:
Root Cause and Corrective Action taken:	
Department	Date:
Preventive Action recommended:	
Evidence for closure:	
Approved	
QMR	Date:
Nonconformity Closed Out.	
Signed Owner	Date:
Data for Analysis:	
Repeat problem? (Circle 1, if Y give reference) Y / N	

AUDIT CORRECTIVE ACTION REQUEST FORM

QF 12	REVISION 00	2014
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	AUDIT CORRECTIVE ACTION REQUEST		
	Issued by: QM	Date:	Revision:
			QF 12

QMS Process:	<input style="width: 95%;" type="text"/>	Audit Date:	<input style="width: 95%;" type="text"/>	IQA #:	<input style="width: 95%;" type="text"/>
Area/Operatio	<input style="width: 95%;" type="text"/>	Auditor:	<input style="width: 95%;" type="text"/>		
Procedure /	<input style="width: 95%;" type="text"/>	ISO 9001:2008	Section <input style="width: 95%;" type="text"/>		

Description of Nonconformity	Category (Circle One) Minor, Major
Signed Auditor Date:	
Accepted/Not Accepted (cross out one)	
Signed Owner Date:	
Root Cause & Corrective Action taken:	
Signed Owner Date:	
Evidence for closure:	
Approved	
Signed QMR Date:	
Nonconformity Closed Out.	
Signed Owner Date:	
Data for Analysis:	
Repeat problem? (Circle 1, if Y give reference) Y / N	

PREVENTIVE ACTION REQUEST FORM

QF 13	REVISION 00	2014
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	PREVENTIVE ACTION REQUEST			
	Issued by:	Date:	Revision:	QF 13

QMS Process:		Date:		PA #:	
Area/Operatio		PA rec. by:			
Reference:		ISO 9001:2008	Section _____		

Recommended Preventive Action		Origin (Tick One) Customer Complaint / CA / Others	
		Recommended by	Date:
Department / person responsible			
		Manager / QMR	Date:
Accepted / Not Accepted (cross out one)			
		Department	Date:
Preventive Action taken:			
		Department	Date:
Approved			
		Manager / QMR	Date:
Data for Analysis:			
Repeat problem? (Circle 1, if Y give reference) Y / N			

MASTER LIST OF RECORDS FORM

QF 15	REVISION 00	2014
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Notes	Order End Date and Signature	Technical signature of receipt	Order Type	Technician Name	Registration Date of Order	Order No.

Signature:	Date:	Maintenance Engineer::
------------	-------	------------------------

MASTER LIST OF RECORDS FORM

QF 15	REVISION 00	2014
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Record	File Location	Authority	Minimum Retention	Disposition
Management Review Minutes	Quality Assurance	QMR	3 years	Archive 7 years Destroy
Training, education skills, and experience records	Personnel Files Department Files	Human Resources Dept. Mgrs.	Employment plus 3 years	Archive 2 years Destroy
Supplier Evaluations	Purchasing	Purchasing	5 years	Destroy
Purchase Orders	Purchasing	Purchasing	5 years	Archive 2 years Destroy
Completed Projects	COO	COO	7 years	Archive
Projects Record	Factory	Production Manager	7 years	Archive
Internal Audit Records	Management Rep	Management Rep	3 years	Destroy
Non-conformance Reports	Quality Assurance	Management Rep	3 years	Destroy
Corrective Actions	Management Rep	Management Rep	5 years	Destroy
Preventive Actions	Management Rep	Management Rep	5 years	Destroy
Document Masters	Document Control	Management Rep	5 years	Destroy
Customer Complaints	Quality Assurance	Management Rep	3 years	Destroy

Preventive or Corrective Maintenance Report Form

QF 16	REVISION 00	2014
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Contractor Technician Name:

End User Name:

Extension Number.

Type of Problem

Order Date Receive (To Help Dick).

Order Date Receive (to Contractor)

Time & Date of complete Work.

Description of what has been done:

.
.
.

Contractor Manager:

.....

Master list of Corrective or Preventive Request Form

QF 17	REVISION 00	2014
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Report number	Technician Name	Name the End-user	Ext. Number	Type of Problem	Receive Date to Help Disk	Receive Date to Contractor	End Date	Date of completion of maintenance	Report number

Weekly Preventive Maintenance for Electricity

QF 18	REVISION 00	2014
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EQUIPT.TAG : _____
UNIT TYPE : _____
LOCATION : _____

ELECTRICAL MAINTENANCE PROGRAM

WEEKLY	WEEK # 1	WEEK # 2	WEEK # 3	WEEK # 4
<i>ELECTRICAL DISTRIBUTION PANELS INSPECTION IN ALL FLOOR</i>				
<i>INSPECTION OF AIR COMPRESSORS</i>				
<i>PERFORM STANDBY GENERATOR DRY-RUN TEST</i>				
<i>PERFORM AUTOMATION FUNCTION AND</i>				
<i>INSTRUMENTATION CALIBRATION</i>				

PERFORM BY:
NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

PERFORM BY:
NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

Weekly preventive Maintenance For Generators

QF 19	REVISION 00	2014
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GENERATOR DRY RUN LOG SHEET

DATE	Week 1 2 3 4					Week 1 2 3 4				
Run Time: _____ to _____	NO LOAD TEST LOG					NO LOAD TEST LOG				
DESCRIPTION / LOCATION	Standby log	Normal Run time	Prior shutdown	Cooldown log	COMMENTS	Standby log	Normal Run time	Prior shutdown	Cooldown log	COMMENTS
AUTO -STARTING OF GENSET.										
AUTO LOAD TRANSFER SWT. ACTION.										
RUNNING TIME METER										
AMBIENT TEMP IN Deg.C										
LUBE OIL PRESS IN kPa										
LUB OIL TEMP. IN Deg.C										
ENGINE COOLANT TEMP.										
EXHAUST STACK TEMP. in Deg. C										
ALTERNATOR VOLTAGE										
PHASE A										
PHASE B										
PHASE C										
PHASE AN										
PHASE BN										
PHASE CN										
ALTERNATOR CURRENT / PHASE										
PHASE A										
PHASE B										
PHASE C										
POWER IN KW.										
FREQUENCY IN HZ.										
POWER FACTOR										
BATTERY CHARGER CURRENT IN AMP.										
BATTERY VOLTAGE										
ALTERNATOR STATOR TEMP.Deg.C										

PERFORM BY:

Name : _____

: _____

TITLE : _____

DATE : _____

APPROVED & ACCEPTED BY:

NAME : _____

TITLE : _____

POSITION : _____

DATE : _____

Weekly Preventive Maintenance for Chillers

QF 20	REVISION 00	2014
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EQUIPT.TAG : CH # _____
UNIT TYPE : CHILLER UNIT
LOCATION : ROOF TOP, OFFICE BLDG.

CHILLER UNIT MAINTENANCE PROGRAM

WEEKLY	WEEK # 1	WEEK # 2	WEEK # 3	WEEK # 4
PERFORMED DAILY ROUTINE				
CHECK COMPRESSOR OIL LEVEL AND TEMPATURE				
CHECK SUCTION SUPERHEAT/SYTEM AS PER UNITS PMR.SCHEDULE				
CHECK FAULT HISTORY EACH UNIT AND TAKE ACTION AS REQUIRED				
CHECKED PUMPDOWN FUNCTION				

NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

Weekly Preventive Maintenance for Air Units

QF 21	REVISION 00	2014
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EQUIPT.TAG : AHU# _____
UNIT TYPE : AIR HANDLING UNIT
LOCATION : _____

AIR HANDLING UNIT MAINTENANCE PROGRAM

WEEKLY	WEEK # 1	WEEK # 2	WEEK # 3	WEEK # 4
ABSOLUTE FILTER				
BAG FILTER				
BELT DRIVE GENERAL CONDITION & TENSION				
CYBERTRONIC CONTROL SYSTEM SETPOINT				
DRIVE MOTORS ELECTRICAL SAFETY & CONTROL				
ELECTRICAL FLEXIBLE CONNECTION				
FAN BEARING ASSEMBLY LUBRICATION				
FAN WHEEL GENERAL CONDITION				
FIN BLOCK				
PRE-FILTERS SET				
ROLL FILTER				
UNIT DRAINAGE SYSTEM				

NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

NAME: _____
SIGN. : _____
TITLE : _____
DATE : _____

EQUIPT.TAG : PMP #

UNIT TYPE : _____

LOCATION : _____

WATER PUMP UNIT MAINTENANCE PROGRAM

WEEKLY	WEEK # 1	WEEK # 2	WEEK # 3	WEEK # 4
<i>SEAL COOLING SYSTEM</i>				
<i>GREASE,OIL CUP,LUBRICATION</i>				
<i>SHAFT SLEEVE NUTS</i>				
<i>COUPLING ASSEMBLY (pump & motor)</i>				
<i>FRAME (check corrosion and paint)</i>				
<i>VENTILATION FINS AND FAN</i>				

NAME: _____

SIGN. : _____

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Appendix E

Publication

Conference	Title	Status @June	Event Photos
11th OMAINTEC 2013 May, Jeddeh	The Common Problems Facing the Building Maintenance Departments	DONE	
12th OMAINTEC 2014 May, Dubai	Implementation the effective concept of quality management in building maintenance department	DONE	
3rd Safety Forum 2014 Febraier, Jeddeh	The Challenges affect the maintenance and safety in public building	DONE	
5th ICESE 2015 April, Turkey	The Common Problems Facing the Building Maintenance Departments	Published Paper	
RICS COBRA 2015 July, Sydney	Understanding the Process of Building Maintenance in Saudi Public Sector	Published Paper	
6th ICCPM 2015 August, Singapore	Quality Manual based on ISO 9001 for Building Maintenance	Published Paper In IJISR	
12th OMAINTEC 2015 Nov, Cairo	An Empirical Study of Quality Management Concepts in the Saudi Building Maintenance Industry	Accepted as Key Speaker	